THE FOUNDRY

Volume 53
Number 7

CLEVELAND, OHIO, APRIL 1, 1925

Published
Semimonthly

Castings Needed As Spring Plowing Begins

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Castings Predominate in Modern Farm Machinery

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Selling Special Castings

Filling the Buyer's Wants in Manganese Steel

By Dan M. Avey

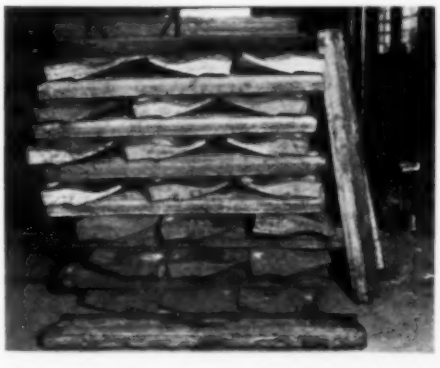
ACCORDING to a popular belief prevailing up to a few years ago, a belief obtaining to a limited extent even to the present among the class which brings up the tail of the industrial procession, the ideal salesman needed or needs no other qualifications than an affable disposition, an ingratiating manner and a liberal endowment of that somewhat intangible but magical attribute referred to as personality. Success of the top-notchers, the high liners in the profession was ascribed to personality plus.

Racks for Steam Shovel Dipper Sticks Are Sold on a Basis of Continued Service

The bag of tricks, the stage accessories of these roving gentlemen included a ready and spontaneous line of conversation, a bubbling camaraderie, an infallible memory for names, faces and dates, an assorted collection of short stories and an unfailing supply of small gifts. The stories were classified roughly to meet the requirements of the parlor or the smoking room with a few on the dividing line to be tried out on new prospects. At one time the presentation of gifts was considered an actually necessary preliminary measure, a figurative greasing of the launch ways to ease the passage of the order into the salesman's book.

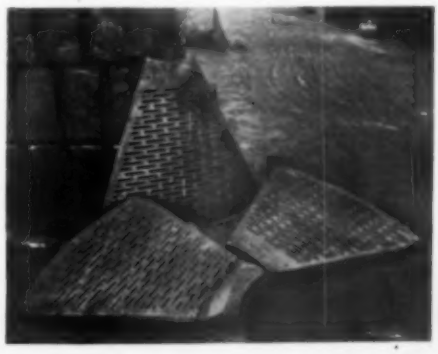
A well grounded knowledge of product he expected to sell was not considered a necessary part of a salesman's education. If he knew the *talking points*, his immediate superiors were satisfied, he was fully equipped to meet every situation and to represent his house under any and all conditions with dignity and profit. That standardized phrase *talking points* is significant. Usually it included such important and closely related features as the surface appearance of the product and the reputation and former business activities of the company's own sales manager. Instances are not unknown where it was nothing but boast and bombast. Perhaps a nicer shade of meaning might be conveyed by a four letter word also commencing with *B* smuggled into the language in recent years and not yet officially recognized.

In the great majority of cases it stopped just short of telling the buyer anything about the possible service of the goods and seldom indeed did it refer even remotely to the technical phases of manufacture or design. Why should a high powered salesman clutter up his mind with a lot of burdensome and smudgy detail? His business was to sell the goods. What did he care how they were made, or who made 'em? He did not want any person to get the impression he was one of these here owl eyed, peering engineers or one of these oil soaked birds in overalls who infest manufacturing establishments. No sir. He wore a collar, stopped at the leading hotels and traveled on an expense account.

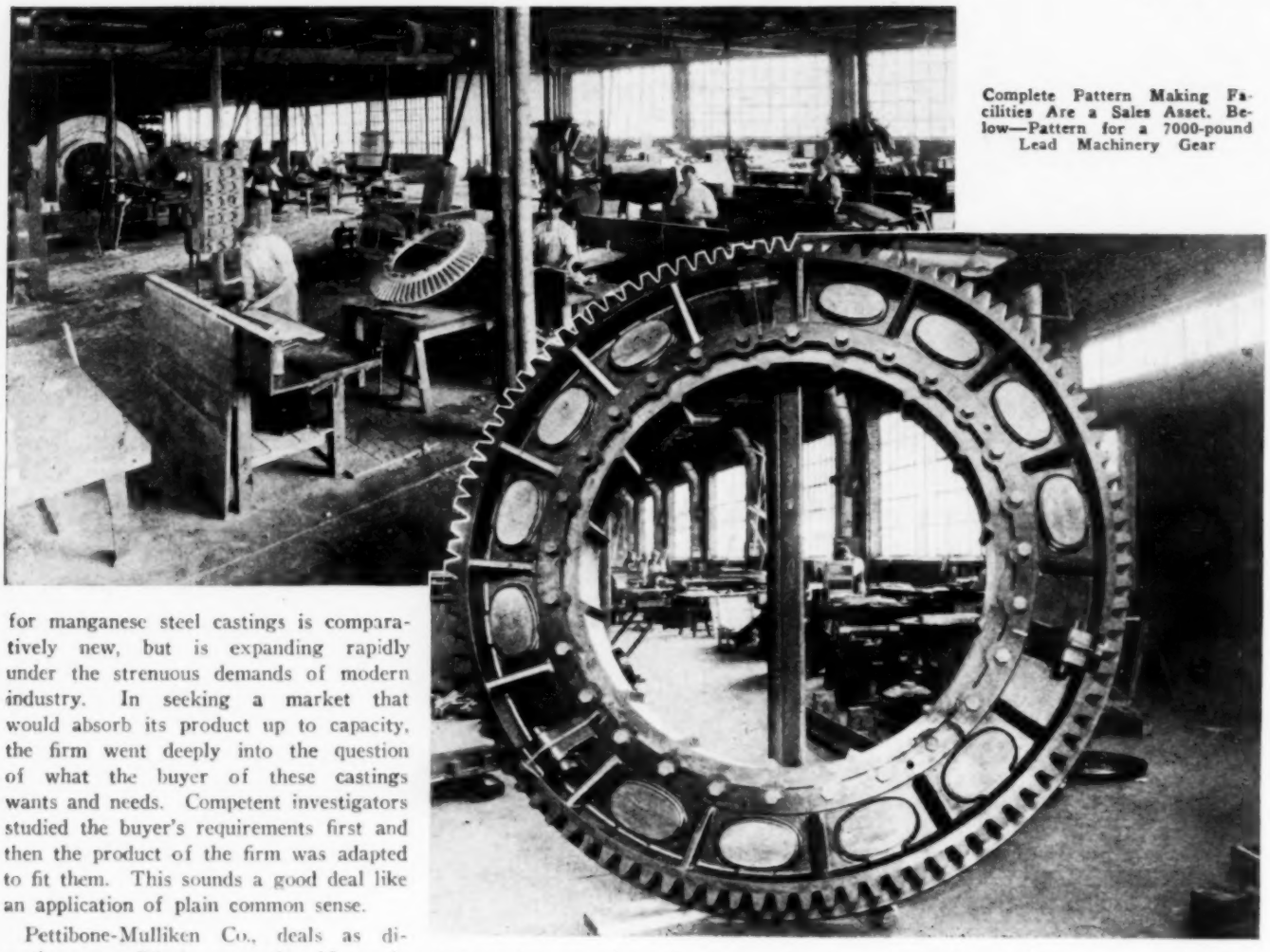


Manganese Steel Gives Excellent Service in Liners for Ball Mills

An interesting example of the extent to which sales methods have changed in recent years is presented by the Pettibone-Mulliken Co., Chicago, manufacturer of manganese steel castings to the extent of 800 tons a month. The field



Screens for Cement Mills Must Resist Grinding Action from Within



Complete Pattern Making Facilities Are a Sales Asset. Below—Pattern for a 7000-pound Lead Machinery Gear

for manganese steel castings is comparatively new, but is expanding rapidly under the strenuous demands of modern industry. In seeking a market that would absorb its product up to capacity, the firm went deeply into the question of what the buyer of these castings wants and needs. Competent investigators studied the buyer's requirements first and then the product of the firm was adapted to fit them. This sounds a good deal like an application of plain common sense.

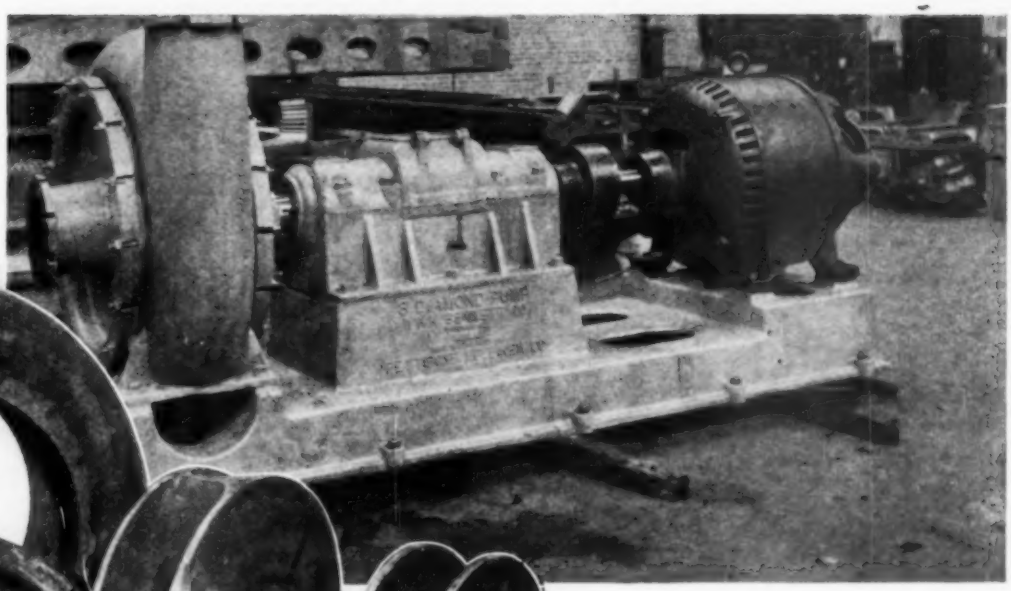
Pettibone-Mulliken Co., deals as directly as possible in presenting it's products to the user. Advertising is employed to establish confidence. Sales letters describe the facilities of the plant for turning out high class castings. Salesmen maintain close contact with the customers and through constant study of what is wanted are in a position to fit their product and service to the buyer's demand.

The manner in which the salesmen work is worthy of attention. By telephone and personal calls they anticipate the time the buyer will be interested. They familiarize themselves with details of service required from the castings they sell. They are prepared to back their statements of quality by proofs of previous service. The policy of the company absolutely forbids wild promises, exaggeration, or questionable statements. Salesmen confine their statements within the limits of their own experience when making promises touching on the anticipated life of the castings they sell for any particular purpose.

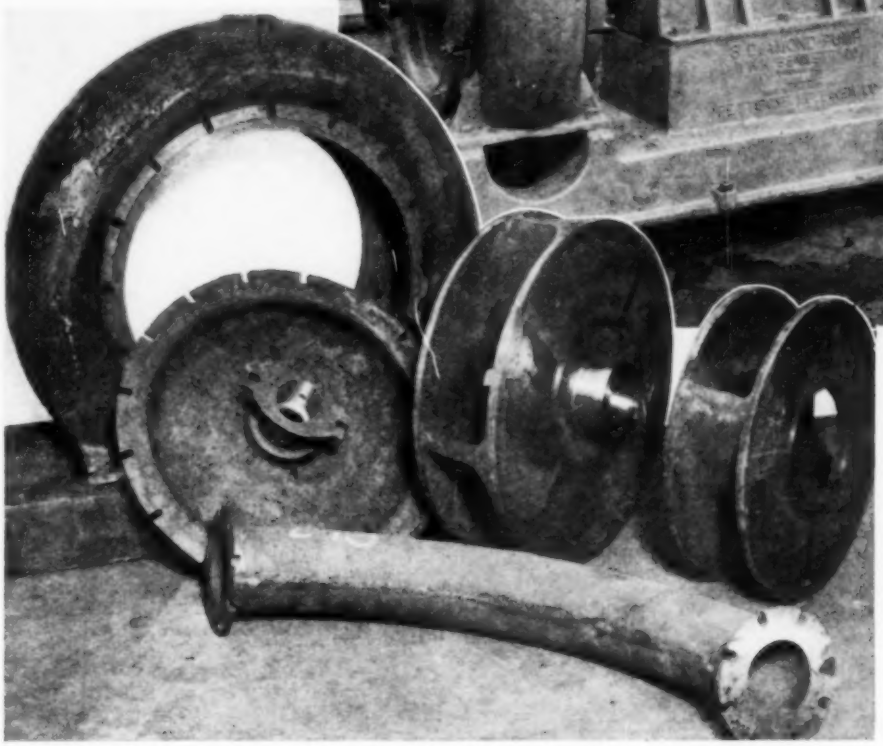
Manganese steel to a marked degree resists abrasion, cutting and crushing stresses and frictional wear. Prospective manganese steel customers were studied by the sales department and classified according to the foregoing requirements. The list includes makers of heavy presses; grinding and crushing machinery; mining and smelting equipment; crane, dredge or digging apparatus; mill or other machinery drives exposed to abrasive grit; conveyors, screens and pulverizing machinery; tramways and cable systems; special railroad equipment; miscellaneous wheels and gears. A practically complete list of the uses for which manganese steel castings are recommended and adapted is shown in the accompanying table.

No systematic research department is maintained expressly to find new outlets for the product, but all the salesmen with years of valuable experience to their credit, constantly are on the alert for future possibilities. A recent order for railroad car striking plates serves to illus-

Left—Miscellaneous Sheave Wheels Are Made for Use With Cable or Chain. Bevel Gears Are Rough Ground Between the Teeth



Pumping Machinery for Handling Sand on Dredging Operations Must Be Wear Resistant. Below—Parts for a Heavy Duty Centrifugally Operated Pump

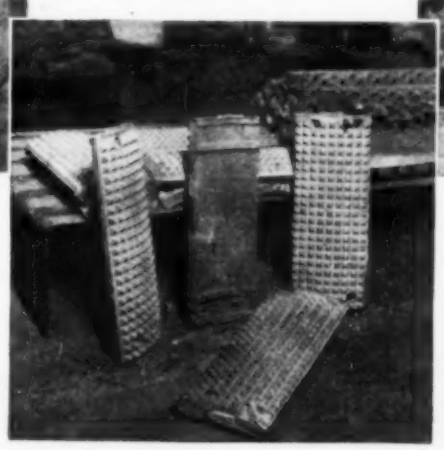


trate a case in point. These plates are attached to the ends of the cars to absorb the shock when the cars bump in coupling or in an emergency stop. Also they are subjected to a combined rubbing and grinding action. A trial order from a western road has resulted in supplementary sales.

Having established basic groups, a more detailed study was made of the individual requirements of the component parts of each group. Approaching a prospective customer and telling him that manganese steel castings are hard and tough was recognized as having merit, but it was felt the statement was not sufficiently comprehensive. The fact that the metal showed a tensile strength of 95,000 pounds per square inch might be interesting, but how did that feature apply to a definite case? Never mind talking generalities. Come down to brass tacks.

The company recognized the legitimacy and propriety of these inquiries. It went a step further and anticipated them. Each individual casting was regarded as a finished part subject to particular requirements. Further, the operation in which each casting was to play a part was analyzed. The following examples will illustrate the manner in which this phase of the selling problem was approached and solved in the organization.

Rings for Mining Concentrator Plants, Gyratory Crusher Heads and Plates for Coal Crushers Are Saleable in Manganese Steel



A rack is a vital operating part on a steam shovel and simply is a gear flattened out in a straight line. Racks are fastened to the dipper stick and serve to move the stick with bucket attached, up and down. Motion is imparted by a pinion mounted on a suitable shaft and engaging the teeth of the rack. The pinion is driven by a bull gear on the main shaft of the engine.

Personal investigation on the part of the sales force disclosed the fact that some of the worst and most frequent wrecks in steam shovel operation resulted from faulty racks. They were not perfectly straight. Obviously high points on the rack will cause the pinion to bind as the shaft passes up and down. The back of the rack must be perfectly flat and straight and also must exactly parallel the face of the teeth.

Manganese steel castings are so hard and tough that they only can be finished by grinding. Formerly, the back of the rack was ground flat under a swing grinder. The face was tested with a straightedge so that it might fit snugly against the plate on the dipper stick, but no attempt was made to check, to assure that it was parallel with the face of the teeth with the back face. As a result of information relayed from the sales force to the shop a new method has been adopted. The rack is fastened to a machine table and the back of the rack is made parallel by a surface grinder.

Develop Wide Range of Service

Manganese Steel Castings Adapted to Many Uses

Arms
- Concrete mixer
- Grab buckets
- Clam shell buckets

Backs
- Steam shovel
- Dipper dredge

Bales
- Steam shovel
- Dipper dredge

Balls
- Rolling mill
- Ball mill

Bands
- Steam shovel
- Dipper dredge

Bars
- Dredge—placer gold
- Grizzly bars
- Jail work
- Pulverizer

Beams
- Plows

Bearings
- Gyratory crusher

Beaters
- Pulverizer

Blades
- Pulverizer
- Pug mill

Bodies
- Safe and vault work

Bottoms
- Steam shovel
- Dipper dredge

Bowls
- Kinkead mill

Boxes
- Rolling mill

Buckets
- Elevator
- Dipper dredge
- Conveyor
- Handling

Bushings
- Clam shell buckets
- Ditching machine parts
- Dredge—placer gold
- Grab buckets
- Helicoid conveyor
- Orange peel
- Miscellaneous

Cams
- Brick and tile machines
- Stamp mill

Cans
- Gyratory crusher
- Helicoid conveyor

Casings
- Brick and tile machine
- Helicoid conveyor
- Pulverizer
- Pump—centrifugal

Castings
- Emery mill crusher
- Rolling mill

Chain
- Box car loaders and unloaders
- Ditching machine
- Dipper dredge
- Dredge—placer gold
- Elevator buckets
- Screen
- Sprockets
- Steam shovel

Chutes
- Gyratory crusher
- Jaw crusher
- Screen
- Stamp mill

Clamps
- Dipper dredge
- Steam shovel

Concaves
- Gyratory crusher

Cones
- Sample grinder

Covers
- Huntington mill
- Lifting magnets

Crabs
- Rolling mill

Crossings
- Track work
- Frogs
- Crossovers
- Switches

Dies
- Rolling mill
- Sample grinder
- Steam stamp mill

Dippers
- Dipper dredge
- Steam shovel

Disks
- Brick and tile machine
- Pulverizer

Doors
- Safe and vault work

Faces
- Brick and tile machine

Frames
- Dipper dredge
- Jail work
- Steam shovel
- Steam stamp mill

Frogs
- Track work—for steam or electric railways

Fronts
- Dipper dredge
- Safe and vault work
- Steam shovel

Gears and pinions
- Ball mill
- Box car loaders and unloaders
- Brick and tile machine
- Cement kiln
- Chilian mill
- Clay mill
- Coal breaking machinery
- Coke plant castings—by-product
- Concrete mixer
- Copper converter
- Cranes—traveling, locomotive, gantry, ladle
- Crushing roll
- Dipper dredge
- Ditching machine
- Dredge—suction
- Dredge—placer gold
- Gyratory crusher
- Helicoid conveyor
- Hoisting engine
- Huntington mill
- Kinkead mill
- Kominuter
- Lima locomotive—(shay type)—geared
- Log loading machines
- Ore dock
- Packing plant
- Pig casting machine
- Pug mill
- Pulverizer
- Raymond mill
- Reverberatory furnace
- Rolling mill
- Road roller
- Screen
- Steam shovel
- Traction and threshing engine
- Tube mill
- Tumbling barrel

Gudgeons
- Helicoid conveyor

Guides
- Brick and tile machine
- Rolling mill
- Steam shovel and dipper dredge

Hammers
- Emery mill crusher
- Pulverizer

Heads
- Gyratory crusher

Hinges
- Dipper dredge
- Steam shovel

Hooks
- Stump pulling machinery

Hoppers
- Gyratory crusher
- Sample grinder

Impellers
- Pump parts—centrifugal

Inserts
- Track work—for steam or electric railways

Keepers
- Dipper dredge
- Steam shovel

Knives
- Brick and tile machine
- Dredge—suction
- Pug mill

Land sides
- Plow

Latches
- Dipper dredge
- Steam shovel

Leaves
- Orange peel buckets

Levers
- Ore car

Liners
- Ball mill
- Dredge—placer gold
- Kominuter
- Ore dock
- Pump—centrifugal
- Safe and vault work
- Screen
- Stamp mill
- Steam stamp mill

Links
- Dredge—placer gold
- Log loading machines
- Pig casting machine

Lips
- Clam shell buckets
- Ditching machine
- Dredge—placer gold
- Grab buckets
- Steam shovel and dipper dredge

Lugs
- Brick and tile machine
- Dipper dredge
- Steam shovel

Mantles
- Gyratory crusher

Mates
- Track work—for steam or electric railways

Mauls
- Tamping and paving

Mortars
- Chemists' supplies

Mullers
- Clay mill
- Kinkead mill
- Sand mixer

Nuts
- Emery mill crusher

Paddles
- Concrete mixer

Pestles
- Chemists' supplies

Picks
- Road roller

Pins
- Coke plant castings—by-product
- Dredge parts—placer gold
- Fuller mill
- Grab buckets and clam shell buckets
- Orange peel buckets
- Pig casting machine
- Steam shovel and dipper dredge

Pipes
- Dipper dredge
- Steam shovel

Plates
- Ashphalt presses
- Ball mill
- Clay mill
- Coke plant castings—by-product
- Crushing roll
- Dredge parts—placer gold
- Emery mill crusher
- Freight and passenger car
- Gyratory
- Jaw crusher
- Kominuter
- Pig casting machine
- Steam shovel and dipper dredge
- Steam stamp mill
- Switch engine
- Tube mill

Points
- Dredge—placer gold
- Orange peel buckets
- Plow
- Track work—for steam or electric railways

Propellers
- Marine castings

Pushers
- Fuller mill

Racks
- Coal mining machine—electric
- Coke plant castings—by-product
- Copper converter

(Concluded on Next Page)

Manganese Steel Castings Adapted to Many Uses

(*Concluded from Page 264*)

Dipper dredge
Steam shovel

Rims
Clay mill
Lima locomotives—(Shay type)—geared

Rings
Chilian mill
Fuller mill
Huntington mill
Pulverizer
Raymond mill

Rollers
Box car loaders and unloaders
Brick and tile machine
Cement kiln
Coal breaking machinery
Concrete mixer
Copper converter
Dredge—placer gold
Emery mill crusher
Kent mill
Log loading machines
Pig casting machine
Raymond mill
Rolling mill
Screen

Runners
Pump—centrifugal

Scrapers
Clay mill

Screens
Screen

Screws
Brick and tile machine
Helicoid conveyor

Sections
Dredge—placer gold
Screen
Steam stamp mill

Shafts
Chilian mill
Clay mill

Shanks
Orange peel buckets

Shares
Plow

Sheaves
Coke plant castings—by-product
Dipper dredge parts
Steam shovel
Heavy duty cable
Miscellaneous

Shells
Center plates
Crushing roll
Huntington mill
Pulverizer
Rolling mill
Sample grinder

Spiders
Gyratory crusher
Screen

Spindles
Rolling mill

Sprockets
Box car loaders and unloaders
Coal mining machine—electric
Ditching machine
Dredge—placer gold
Elevator buckets
Log loading machines
Pulverizer
Screen

Staves
Tumbling barrel

Strips
Screen
Steam stamp mill

Supports or toes
Clay mill

Teeth
Coal breaking machinery
Ditching machine
Dipper dredge
Dredge—placer gold
Scarifier
Steam shovel

Tires
Cement kiln
Clay mill
Chilian mill
Concrete mixer
Dredge—placer gold
Screen
Sand muller

Tongues
Track work—for steam or electric railways

Toothed segments
Coal breaking machinery

Trays
Clam shell buckets
Grab buckets

Trunnions
Dipper dredge
Steam shovel

Tumblers
Dredge—placer gold

Valves
Steam stamp mill

Wheels
Charging buggy for blast furnaces
Coal mine car
Coke plant castings—by-product
Crane—traveling, locomotive, gantry, ladle
Ditching machine
Dredge—suction
Dredge—placer gold
Grab buckets and clam shell buckets
Mine car
Orange peel buckets
Ore car
Ore dock
Packing plant
Reverberatory furnace
Rolling mill
Skip car
Slag car
Sprockets
Stripping car
Tramways and cable haulage systems

Winding drums
Hoisting engine
Steam shovel and dipper dredge
Stump pulling machinery

Wobblers
Rolling mill

Yokes
Fuller mill
Road roller

Apparently precision methods are appreciated. Satisfactory business is reported from both manufacturers and users.

The largest demand for manganese steel castings originates with the builders of heavy duty machinery. Notwithstanding occasional cynical comment to the contrary, machinery builders are *not* keen for the profit derived from supplying repair parts. They recognize the necessity of supplying parts for those which wear out in a reasonable period of time, but the word *breakdown* is about as welcome to them as it is to the operator of the machine. They realize their best interests are served by steady, consistent and satisfactory performance on the part of machines that bear their name or trademark.

Manufacturers of clay working and brick making machinery rapidly are substituting manganese steel for material formerly employed in parts subjected to strain and excessive wear. Clay has a decidedly destructive effect on the machinery employed in its manipulation. In making brick, clay is mixed to a thick heavy consistency in a pug mill and then forced through a die of the required lateral and vertical dimensions. The long, continuous clay slab is cut to the required brick length while in motion by a series of wires that rise and fall automatically above the table holding the slab.

Other metals in the roll shells were employed for many years as an agent for crushing the clay and extracting the stone preparatory to feeding the clay through the pug mill and brick machine. These metals rendered fairly satisfactory service, but due to the severe abrasive action of the clay and the presence of tramp materials, such as spikes and bolts, their life was comparatively short and uncertain. Trial of manganese steel convinced brickmakers that although at first it costs more, ultimately it is cheaper. The determining factor was not the original cost of the casting, but the time saved on breakdown repairs and the gain in production due to uninterrupted operation.

By way of experiment a large eastern

CUSTOMER				DATE OF INQUIRY		P M CO BID NO.			
ARTICLE				DATE OF ESTIMATE		DELIVERY PROMISED			
QUANTITY WANTED	CUSTOMER'S P-P NO.		CUSTOMER'S PATT. NO.	P M CO P-P NO.		P M CO PATT. NO.			
PATTERN RECEIVED		PATTERN SHIPPED		ESTIMATED COST		ACTUAL WEIGHT		ACTUAL COST	
METAL									
MOLDING									
COREMAKING									
ROUGH GRINDING									
STRAIGHTENING									
BROACHING									
TREAD									
HUB									
BORE									
KEYWAY									
INSERT									
		O H							
PATTERN COST—LABOR		MAT'L							
TOTAL			SALE PRICE	F. O. B.					

The Engineering Department Gives Full Details in Estimates to the Sales Force

steel company decided to try a set of manganese steel gears in the screw-down on its blooming mill rolls. The gear maker claimed the castings would render satisfactory service while the mill was rolling at least 150,000 tons. The mill men professed that such an extended performance would justify amply the increased cost of the wheels. As a matter of record it is stated these gears remained in constant service until the mill had rolled over 1,000,000 tons of steel.

Co-operation between the sales and operating force has been established to such an extent that when a salesman books an order he sets a delivery date in the absolute assurance that it will be observed. All work is estimated by the engineering department from data provided by the salesman. The form used in making up the estimates is shown in an accompanying illustration. The sales force is provided with information on every detail entering into the costs. His submitted figures are certified and backed by the judgment of the operating force. Prices are quoted on a pound basis.

Wherever possible the company specifies that it shall furnish the necessary patterns. This practice has many desirable features. Experience is required to adapt patterns to the peculiar foundry problems incident to the production of manganese steel castings. The practice also forestalls and prevents acrimonious contention which sometimes arises over the cost incident to changing patterns provided by the customer. Patterns are retained and stored without expense to the customer and insurance is provided under the general insurance policies carried by the Pettibone-Mulliken Co.

When a contract is signed it is sent through the downtown office which has full details on file as given in estimate form. The order then is transmitted to the plant at Cicero, a suburb of Chicago, where the production department schedules it definitely according to a standard routing formula. Each day's production is arranged in advance. Regular orders are given white job tickets. Rush orders carry red cards. Castings which must be remade are indicated by green cards. An unwritten rule of the company, which up to the present has found no ground for enforcement, is to the effect that any foreman who fails to remove the day's green tickets from the board, is fired. Under ordinary conditions the shop routine disposes of jobs from receipt of the order to the delivery of the finished casting in five weeks.

The company maintains an open door policy and wherever possible induces prospective customers to visit the plant and note the exceptional facilities for producing quality castings. The proprietors and in an exceptionally clean, neat, well appointed and well equipped shop which was described by Pat Dwyer in the Feb. 1 issue of THE FOUNDRY.

Castings are cleaned, annealed and finished in a department that is a distinct asset to the sales department. From the annealing ovens all castings are delivered to the grinders on pressed metal stands similiar to those shown in the accompanying illustrations. Any rough fins previously have been removed in the casting shop. All gears are ground on the face which render them accurate within a few hundredths of an inch. This treatment is recommended by the engineering department which also backs its executive force display a legitimate pride judgment on manganese steel gears for an average peripheral speed of 600 feet per minute.

The ingredients for manganese steel castings are melted in electric steel furnaces and the composition of the charge is manipulated to meet different analyses and physical requirements. Preliminary tests are made of all heats to assure proper analysis of the steel for the purpose. All castings received the same subsequent heat treatment unless special requirements introduce the necessity of meeting special physical specifications out of the ordinary.

Discuss Heat Treatment of Cast Iron

Heat treatment of cast iron at the Holt Mfg. Co., Peoria, Ill., was described in a paper, compiled by Fred Grotts, M. L. Frey and E. C. Alexander, metallurgists, and read by Mr. Frey before the Chicago chapter of the American Society for Steel Treating, March 12. Summarizing the paper averred that hard spots, due to combined carbon may be removed by heating to 1750 degrees Fahr. that there is a certain application for hardening and drawing cast iron, that cast iron to which steel has been added has increased tensile strength, that alloy cast iron is a field to be developed, that chilled iron can be softened, then rehardened, and that white iron can be graphitized quickly by heating to 1750 degrees Fahr., then being quenched and drawn.

Referring to chilled iron the paper said: "To prevent excessive scraping of raw material and trouble from burnt tools, castings are routed direct to the heat treating department and annealed (heated to 1750 degrees Fahr. for a short time), then the machining operations are preformed and the parts rerouted to the heat treating department for quenching and drawing. This gives a hardness practically equivalent to the original chill and without tool trouble or loss of material. Physical tests of this treated material show a 5 per cent increase in strength over standard chilled iron or untreated iron."

When cylinders and pistons of soft gray iron are taken direct from the foundry to the machine shop, trouble is experienced from distortion due to the relieving of strains, the paper stated. When it is not possible to season these castings, it is the procedure of the Holt company to anneal the castings at a temperature of about 600 degrees Fahr. This relieves the strains without undue softening and weakening of the material.

It was stated that white iron may be broken down quickly by heating to 1800 degrees Fahr. By quenching in water and drawing at approximately 1300 degrees Fahr. a product is obtained that is readily machineable and has good strength. High ductility which is one of the essential requirements of high quality malleable iron is lacking.

The paper cited a typical soft iron, the analysis being 3.5 carbon, 0.35 manganese, 0.11 sulpher, 0.45 phosphorus and 2.75 to 3 silicon. The general properties of this cast iron were low. Its tensile strength averaged 18,000 to 20,000 pounds per square inch and its sceleroscope hardness was 26 to 30. By quenching this stock from a temperature of 1550 degrees Fahr. a noticeable increase in hardness was observed. An average of 50 has been obtained in treating a large number of cylinder heads. It should be observed that when a sceleroscopic harness of 50 to 60 is obtained it is customary to draw it back to 35 to 40.

To salvage castings where defects are found on finished surfaces an alloy of copper and nickel is used in connection with the electric arc according to the paper. This weld is machineable and has a good bond with iron. It has good properties which reduce to a minimum the chances of cracking It was stated that application of this alloy could be greatly increased in connection with the electric aro as the acetylene torch requires extensive preheating and high temperatures. The paper declared it practical to braze as a salvaging proposition. Because castings can not be welded without later being annealed does not mean that brazing is out of the question, it was claimed.

Shipments and unfilled orders, according to data supplied to the department of commerce by principal locomotive manufacturers, showed declines for February from both the previous month and a year ago.

Practice Limits Refractory Life

By James T. MacKenzie

MR. MacKENZIE entered the service of the American Cast Iron Pipe Co. immediately after graduation from the University of the South, Sewanee, Tenn., in 1912, working in various plant departments.

HE WAS made chemist in charge of melting and mixing in 1914 and relieved of routine in 1918 to devote all time to experimental and research work.

HOLDS membership in leading technical societies and is author of numerous papers including the following which was presented at the Columbus convention of American Ceramic Society in February, 1925.

LIFE of the refractory lining of the cupola furnace depends on its successful resistance to three direct influences; namely chemical, mechanical and physical.

The chemical is the solvent action of the slag and the chemical union of the basic oxides of the charge with the silica of the lining. The action of iron oxide at high temperatures in the presence of molten iron is more severe than commonly is known. An illuminating experience is the search for a crucible material described by Messrs. Tritton and Hanson in a paper on iron and oxygen read at the fall meeting of the Iron and Steel institute, 1924. The authors state that crucibles of silica, china clay, and alundum were tried, in none of which was it found possible to hold molten iron containing much oxide for more than a few minutes owing to the rapid attack of the pots by the oxide.

The mechanical influence is the actual grinding off of the blocks by the descent of the charge and the ascent of the gases carrying suspended particles of abrasive or corrosive materials. Sharp corners on large pieces of coke and iron are particularly destructive in the stock, while sand and fine coke are pre-eminently abrasive when caught in the blast. Slag also is blown considerable distances up the stack and freezes onto the brickwork.

The physical influence is the actual melting off of the ends of the blocks in the melting zone where temperatures of 1600 degrees Cent. and over are encountered; the spalling of the blocks and rupture of the mortar joints when subjected to changes of temperature incident to intermittent operation and abuse in operation such as rough treatment of the lining in chipping, drying and charging.

These three forces are at work and each one exerts a profound influence on the resistance of the block. For instance, the impregnation of the blocks above the melting zone by slag and iron oxide, though not sufficient to cause them to melt off, accelerates the mechanical and physical losses by making them brittle and sensitive to temperature changes. Conversely, the continued erosion at this same point constantly exposes a fresh surface to the slag attack. The rupture of the mortar joints from physical causes allows slag to attack the block on greatly increased surface area and often allows the blast to escape through them carrying slag, grit, dust, etc.

To describe the effect of variations in practice on the life of the blocks a brief statement of the operations involved is essential. Starting from the shell of riveted or welded steel plate with openings for the charging door, tuyeres, slag hole and tap hole, and the tuyeres in place of the size number, and disposition specified by the builder, the lining of blocks is put in. Angle irons usually are provided beginning 2 or 3 feet above the tuyeres and at intervals of about 3 feet to the charging door. Blocks are laid from the mantel to just above the charging door unless iron blocks are used at the latter point, when a belt of the latter about 3 feet in width is put on top of the refractories. These are valuable in long heats when most of the charging is done after the cupola is filled. The utmost care is taken in the lining of the hearth and above the top of the tuyeres. Courses are staggered so that vertical joints do not coincide.

The lining is painted with a thin wash of fire clay and dried thoroughly without forced draft. The shell should become too hot to touch before this firing is finished. The bottom is dropped, the surface allowed to cool and another application of thin mortar made to the surface of the blocks. The furnace then is prepared for the heat. The doors are put up, bottom rammed in, and enough wood put in to insure the ignition of the coke. Approximately two-thirds of the bed coke is charged and the torch applied. When the wood is consumed and the coke shows red around the edges and at all the tuyeres the bed is brought to the proper height with such of the remaining coke as is necessary, using a measuring rod to insure accuracy, the tuyeres are closed, the breast put in and the furnace is ready for charging. Steel, if used, pig, and scrap, in the order named, are charged carefully into the furnace, every precaution being taken to avoid striking the walls with any of the heavy pieces, and at the same time giving the charge as good distribution as possible. A charge of coke is put in evenly, followed by the limestone, and successive charges of iron,

coke and limestone follow with more emphasis being placed on distribution and less on possible damage to the lining as the stock line approaches the charging door. When this point is reached the furnace is ready for the blast.

Describes Melting Zone

The blast enters through the tuyeres and passing through the ignited coke burns it to carbon dioxide with evolution of heat. The reaction is chemically expressed as, $C+O_2=CO_2$. The dioxide passing over the heated coke reacts with it to form monoxide, $C+CO_2=2CO$. This reaction, being endothermic, tends to cool the blast. The maximum of dioxide and the minimum of monoxide and oxygen occurring at a roughly conical surface usually some 12 to 24 inches from the tuyeres—the distance depending on the velocity of the blast and the reactivity of the coke. The melting zone of the cupola is the region beginning where the reaction $C+O_2=CO_2$ has raised the temperature above the melting point of the iron and ending where the reaction $C+CO_2=2CO$ has reduced the temperature below that point. A great amount of heat is absorbed by the iron in melting, but the fact remains that there is still a distinct melting zone even in the absence of iron. Ordinarily this zone is about 4 inches deep and the greatest destruction of the refractories occurs at the point where it intersects the lining.

The first action of the blast is to burn away enough coke to allow the metal of the first charge to come down into the melting zone. It is there melted and trickles down through the coke to the hearth whence it is drawn off as required. The ash of the coke, the sand of the pig, and the limestone combine to form slag, which follows the iron down and is drawn off from time to time as it accumulates. It is sometimes allowed to run out on top of the iron, whence it is romoved in various ways. By the time the charge is melted another charge of coke drops into place and the process goes on. It is necessary to have sufficient coke in the charge to fill the melting zone completely and it is necessary not to have more iron in the charge than the coke in the melting zone is able to melt, otherwise the bed coke would be used up, the iron allowed to come down to the lower temperature, or higher oxygen region the iron being burned and the refractories damaged. If the bed is not quickly replenished melting stops and the bottom must be dropped.

When the required amount of iron has been placed, the charging is stopped and the cupola blown out. This is a trying time for the refractories for there is no fresh cold stock going in to absorb heat and filter the drops of slag and iron out of the blast. Inspection at this time will show a veritable shower of these globules and particles of white hot coke shooting up first around the edges and gradually from the whole bed, many of them sticking to the brickwork. The particles of iron sticking to the wall burn as soon as the air strikes them, leaving a spot of iron oxide to cause damage on the next heat. When the melting is finished the doors are dropped, the refuse removed and the furnace is cooled.

It is then prepared for the next heat by chipping out all the slag, coke and iron adhering to the walls, especially around the tuyeres where it has been chilled by the cold incoming blast. The melting zone is repaired by *daubing* with a wet mixture of clay and sand, using brick or even blocks if it is deeply attacked. The daubing practically should restore the straight line of the original brickwork but should not be allowed to encroach on the shaft area. The first charge after repairing should be put in meticulously, for if any considerable amount of mud is knocked off of the wall the blocks are left exposed, and the tuyere below is likely to be bunged up for the heat.

A general inspection of this brief summary shows that there are three principal factors to consider: the lining, its chemical character and its physical condition; the stock, its chemical character and physical condition; and the blast, its velocity and temperature.

Lining the Cupola

It is not the purpose of this paper to discuss the properties of the blocks themselves. It is assumed that they are true to shape and free from visible defects which generally is true of the products of reliable makers. Blocks should be kept out of the weather as serious deterioration occurs upon exposure. The most important item in the lining of the cupola is the clay used as a grout. Unless this is as refractory as the blocks, it melts away leaving the blocks exposed to the destructive influences.

Each block should lie snugly against its neighbors with the least possible amount of filling and should fit closely to the shell. Defects in the shell often cause considerable trouble in this respect—buckles, rivets, and even the desirable angle irons contributing in no small degree to the failure of the blocks.

Daubing the melting zone is the real stumbling block of the cupola tender. The tender has some clay and sand, a mud box and a plasterer's hoe, a hose or perhaps a bucket of water, and a half hour's time with which to repair the lining for another heat. The curious thing about it is not that he so frequently fails but that he ever succeeds. His mud must be wet enough to work easily, but if too wet it will crack and perhaps blow off when heated. It must be sticky enough to adhere to the glazed surface of the blocks, open enough to dry without cracking, and refractory enough to withstand the high temperature of the furnace. In many small foundries a smear of strong molding sand is all that is attempted, but in long heats the mixture of clay and fire sand almost universally is used. The percentages naturally depend on the fatness of the clay. The mixture used by the author for many years was equal parts of a rich yellow clay, a lean fire clay, silica sand, and crushed fire brick. This batch had excellent properties except for its melting point, which was low on account of the highly ferruginous yellow clay. Recently, there has been available a highly refractory fire clay which has eliminated the other two clays. The mixture now is

Scrap Percentages vs. Heats

Per cent scrap

20	25	30	35	40	45	50	60	70	80	90
150	100	110	65	65	80	150	125	110	35	75
150	200	..	..	50	40	110	40	125	40	115
175	100	..	..	60	80	110	70	75	35	75
150	180	..	..	70	130	80	..	15	65	45
130	160	..	..	75	..	110	..	50	35	30
175	125	..	..	75	..	..	..	60	60	100
50	100	..	..	160	..	..	..	75	45	..
160	110	..	..	135	..	..	..	75	..	..
125	200	..	..	75	..	..	..	50	..	..
135	150	..	..	..	..	..	..	..	..	..
140	160	..	..	..	..	..	..	..	..	..
185	135	..	..	..	..	..	..	..	..	..
150	125	..	..	..	..	..	..	..	..	..
...	130	..	..	..	..	..	..	..	..	..
					Average					
144	141	110	65	85	82	112	78	65	45	73

Av. per cent scrap	Heats
20-30	141
35-50	92
60-70	70
80-90	58

equal parts of fire clay, sand, and crushed fire brick prepared in a mill. The improvement in the appearance of the furnaces at the end of the heat has been remarkable with this new clay. In long heats where the cutting under the best conditions runs as much as 3 or 4 inches, the daubing should be used simply as a seating for brick placed flatwise in the ring. Splits are useful for this purpose and should be kept on hand. Mica schist is convenient and satisfactory, though it is not at all porous and the lining must be heated carefully if large pieces are used to prevent the steam blowing them off.

Rush Work Detrimental

An important factor is the time allowed by the working conditions of the foundry for getting the furnace ready for the next heat. It is best to have the furnace put up at night on a separate shift. This often requires cooling off the walls with a hose so that the men can work in the shaft, which sounds like harsh treatment and probably does injure the lining, but good blocks stand it remarkably well. Curiously enough the blocks seem to give better service when the furnace is run every day, even though cooled with water, than when run every other day and consequently allowed to cool naturally. The author has three distinct conditions to handle, a description of which is interesting. First are the large pipe foundry cupolas, two running every day and two every night. The heats are about 10 hours in blast, melting 15 tons per hour. For the day shift they are lighted off at 11 p.m., charging begins at 2 a.m. and the wind goes on at 3.30 a.m., bottom is dropped about 1:30 p.m. and water turned onto the dump immediately. By 5 or 6 p.m. the refuse has been removed and the men are chipping out, copious streams of water being used to cool the stack to the point of tolerance. By 9 or 10 p.m. the daubing is in, and the furnace is ready for another cycle. The night furnaces are on the same basis, placing a.m. for p.m. In the special foundry there are two cupolas which run on alternate days, the shift being about 8 or 9 hours and no water cooling is necessary. In the specialty shop, one cupola is run every day, but as the heats are only about 2 hours, it has ample opportunity to cool off before the tender has to go into it. The following figures tell the story:

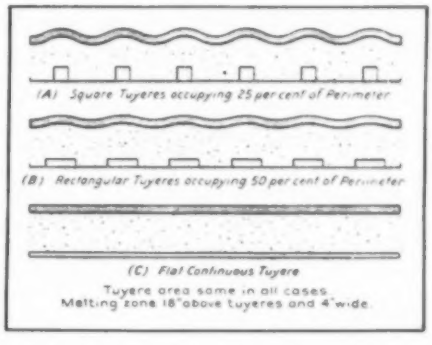
Cupolas	Cooling
Pipe Foundry	Artificial
Special Foundry	Natural
Specialty Shop	Natural

	Life of lining	No. hours heat per lining
Pipe Foundry	6 Months	1500
Special Foundry	12 Months	1300
Specialty Shop	12 months	600

The only explanation is that the pipe foundry cupolas never really get cold, except over Sunday, and they do not suffer as much contraction between heats. The reason for the poor showing of the specialty cupola is that so much of its heat is blowing out, which is particularly hard on the lining.

The cupola charge consists of fuel, flux and metal in the general proportions of about 12 fuel and 2 flux to 100 parts of metal. The properties of any one may greatly affect these proportions and the temperature requirements of the foundry are the prime consideration in fixing the coke, but the general average will not be far from that given.

Practically the only fuel now used is coke. A hard coke is unduly abrasive and a soft coke crushes under the burden, so extremes are undesirable. The relation between structure and combustibility or reactivity has not been determined satisfactorily, but in general


(A) Square Tuyeres occupying 25 per cent of Perimeter
(B) Rectangular Tuyeres occupying 50 per cent of Perimeter
(C) Flat Continuous Tuyere
Tuyere area same in all cases
Melting zone 18" above tuyeres and 4" wide.

THE IDEAL IS THE FLAT TUYERE OCCUPYING THE WHOLE CIRCUMFERENCE OF THE FURNACE

these properties would seem to diminish as the hardness increases. A soft soluble coke would demand a higher fuel consumption than a hard insoluble one with more ash. Hard coke, being less reactive than the soft coke, may save the lining more by reducing the slag than the soft coke would by lower abrasion. The reaction of carbon and carbon dioxide to the monoxide is a function of the time of contact which depends on the surface exposed. Therefore, the smaller the coke the greater the amount lost as monoxide. Small coke should be avoided for this reason as well as for its tendency to pack. The author's experience is that coke of 3 to 5 inches is the most satisfactory.

The amount and composition of the ash is by far the most important characteristic of the coke. The percentage of ash is not the ultimate consideration, for a coke with 10 per cent ash which allows a melting ratio of 10 to 1 will be better than one with only 9 per cent ash which will permit a ratio of only 8 to 1. The author is not familiar with any analytical work on the ash content of the various cokes, but it is apparent that the more iron it contains the greater will be the damage and that the higher the silica present the more flux will be needed to take care of it with consequently more slag to act on the lining. Assuming that there is no difference in the composition of the different ashes and that the efficiency of the fixed carbon is the same, the flux will increase more rapidly than the ash as each increment of ash demands an equivalent of flux, which requires more coke for melting it, which brings in more ash to be fluxed, etc.

Limestone Principal Flux

The principal flux in use is limestone although other forms of calcium carbonate such as oyster shells and marble waste are used where local conditions are favorable. The latter particularly are desirable on account of purity. Fluorspar is used sparingly in some cases and is a quick and valuable means of thinning the slag when it is sticky but should be used only as medicine for it is destructive to the lining.

The most important point to be watched in the flux is the amount of insoluble residue, which is mostly clay and silica. As one pound of sand or clay requires nearly three pounds of calcium carbonate to produce a fluid slag, each per cent of such impurity lessens the amount of available flux by four. This additional slag requires more coke to melt it which adds more ash to be fluxed, etc.

Probably the most desirable charge consists of iron balls 2 or 3 inches in diameter and free from sand and rust. Such a charge would allow perfect distribution in the cupola, and give a minimum resistance to the blast. It would require only sufficient flux for the ash of the coke and would absorb heat rapidly enough for good melting, offering little surface for oxidation. Such an ideal condition is unattainable, but the effect of the actual condition of any given charge may well be measured by its deviation from such a standard. Large and unwieldly pieces of iron such as sows, rolls of various kinds, and all manner of heavy machinery parts are difficult to place properly in the cupola and are slow to absorb heat. Even where the section is not heavy, a large piece such as a plate cuts down the area available for the blast, and thus increases its velocity while at the same time depriving the stock above it of the contact with the hot gases necessary for preheating. Large hollow articles such as stoves, pipe, acid eggs and the like, when charged unbroken, not only divert the blast but, when they do finally melt, cause a sudden rearrangement of the whole body of stock above them with

consequent danger of disturbing the orderly arrangement of the charges. Long pieces such as rails and arbors often get cocked up against the wall and cause trouble from scaffolding.

Fine scrap such as borings, shot, and sweepings has a tendency to run down ahead through the melting zone and into the high oxygen region near the tuyeres where it is burnt and adds more to the slag than to the iron. Where such scrap is rusted, as is usually the case, the trouble is increased. Thin sections such as stove plate suffers from oxidation, 80 per cent being good recovery in the ladle, 20 per cent going to the iron oxide which is the most damaging constituent of the slag. Light steel scrap is even worse for it has not the carbon of the stove plate to protect it.

Pig iron is cast in three ways: in sand molds, in iron molds laid out as the sand molds with sand runners leading to them, and in the chill molds of a casting machine. The sand cast is covered with sand, but usually of appropriate size. The chill cast is fairly clean but often the pigs are too large and heavy to handle. The machine cast is free from sand but is often made too bulky, especially for small cupolas. The effect of sand on the pig is the same as it is in the coke or limestone except that in addition to the increase of flux required it makes the pig more abrasive. It remains then to examine these forms of pig iron from the chemical point of view. The combined carbon is lowest in the sand cast and highest in the machine cast on account of the more rapid cooling of the iron in the latter case. The combined carbon is what determines the melting point and the total carbon determines the freezing point. As an illustration, consider two pure iron-carbon alloys of 4.3 per cent carbon, one of which has been cooled so slowly that all its carbon is free, or graphitic, and the other cooled so quickly that all its carbon is combined. We have in the first case a mixture of pure iron whose melting point is 1535 degrees Cent. with carbon mechanically enmeshed sufficient to lower its freezing point to 1135 degrees Cent. In the second case the melting point is 1135 degrees Cent. which is also its freezing point. It is impossible to melt quickly enough to prevent some solution of the graphite by the dead soft matrix of the gray iron but with the large thick flakes of graphite and the large grains of ferrite usually present in the soft irons, the action is slow until high temperatures are reached. Such a case we might expect a combined carbon of only 2 per cent by the time it begins to melt which would give a melting point of about 1350 degrees, or over 200 degrees higher than that of the white iron. The influence on the lining comes from the necessity of maintaining the bed of coke at a greater height for the chilled iron so that it will acquire the necessary superheat for casting after it is melted, whereas the gray iron possesses it as soon as it becomes molten. Off-grade irons, commonly contain dissolved oxides which are not only destructive to the lining but troublesome in the foundry.

Much has been said about scrap, but from the present point of view it is the most important feature of the charge. Oxidation is undoubtedly the chief cause of its destructiveness especially when using light scrap such as stove plate. The author used for several months a charge of 50 per cent light to medium steel scrap, 25 per cent stove plate, and 25 per cent agricultural scrap and foundry returns. This was for duplexing in a basic electric furnace and was not required to be exceedingly hot, but the volume of slag was enormous. The coke ratio had to be kept at 7 to 1, and the melting zone seldom went ten hours without showing a hot spot. To check up the influence of scrap on the lining the records of the company were carefully preserved from which the table was prepared. These records were only begun in the latter part of 1917, but the period since then includes the interesting experience of the electric furnace which allowed the use of the high percentages of scrap. The accompanying table gives the number of heats per lining listed under the scrap percentage used during its life. There are, of course, inconsistencies but the general trend is striking. Most of the extraordinarily good results on the high scrap mixtures were obtained by relining the melting zone with new blocks. This was not entered in the records as a lining. With low scrap mixtures this is never done as the abrasion in the stack is what determines the life in such a case.

Blast an Important Factor

The chief factors to be considered are velocity, temperature, and the persistence of oxygen. A great deal in this connection may be attributed to the stock as has already been indicated. Large pieces cutting down the area causing a rush of gas through the opening remaining; large coke allowing oxygen to persist throughout the stack; small coke causing channels; slag being too viscous to run out, thus clogging up the furnace around the tuyeres. The fundamental consideration, however, is the size, shape, and distribution of the tuyeres. The ideal is a flat tuyere occupying the whole circumference of the furnace. This gives a smooth shaped melting zone of the same height on the walls everywhere and easy to start off with the correct bed. The accompanying figure shows the intersection of the melting zone with the walls for three types of tuyeres; square, rectangular and the flat. The latter is gradually supplanting the first two. It is apparent that with the first two a level bed will be either too low for just over the tuyeres or unnecessarily high for points between them and it would be impossible to put in a bed of such shape. Upper tuyeres cause a weakness in the most important courses of the blocks and add oxygen to the blast at a troublesome point. They serve no useful purpose, for better results can be obtained by using the correct amount of air through one row of tuyeres if this is of the proper dimensions.

The correct blast pressure depends on the character of the charge, especially the coke, the height of the stack and the diameter of the cupola. It should be sufficient to drive the blast well into the shaft, otherwise, there will be an undue amount passing up against the wall and the interior of the stack column will remain cold. The following figures shows the inside diameters of the cupolas used by the author and the blast pressure found by experiment to give the best results:

Inside diameter, inches	Pressure ounces per sq. in.
66	12-14
60	10-12
54	8-10
42	6- 8
18	3- 4

The attempt was once made during a period of depression to run the 66-inch stacks on a 6-ounce pressure so as to slow them up, but after several freeze ups it was abandoned.

More damage is done to linings and castings by too much blast than by not enough. Chief among high pressure troubles are oxidation of the iron with corresponding increase in the volume and corrosiveness of the slag; bridging or scaffolding at and just over the tuyeres from chilled slag and iron; and a tremendous increase in the abrasive effect of particles of sand, slag, and coke which are blown up the walls like a sand blast. The effects of oxidation are seen in the shortened life of the molten metal and in honeycombed castings. Accidental stoppage of part of the tuyere area by a *drop out* of the daubing frequently causes the phenomenon even under the best conditions, and unless the tuyeres can be opened, the destruction of the lining is severe.

Furnaces running on high pressure are particularly liable to bridge. The trouble starts by particles of slag freezing as they trickle through the cold blast catching coke and iron to form a dense mass that obstructs the wind and gives it increased velocity through the re-

maining space. The effect is cumulative and may even go to complete stoppage of the blast. A poor daubing material will often cause trouble by melting off early in the heat and freezing over the tuyeres and the same may be said of cheap brick used for patching or lining. Not the least trouble from a bridge is the damage to the lining caused by removing it.

Little can be said of the blast temperature as it is obviously dependent on the proportion of iron to coke and on the character of the coke. With a pure, highly reactive, coke good 9-inch blocks may easily be melted through in a few hours. No refractory could be expected to stand such temperatures under the conditions of actual operation. Where excessive temperatures are required for the work, the life of the linings will inevitably be short, but linings are cheaper than rejected castings

In conclusion, it may be said that in one point only does good foundry practice work against the lining and that is high temperature. As the normal working of the cupola gives hot iron, then cold iron is a sure sign that something is wrong. It is better to melt hot and cool with scrap than to court disaster by melting cold. In the last analysis, it is doubtful whether correct melting will attack the lining any faster than cold melting on account of the increased chances of oxidation in the latter. In all other respects the interests of the foundry and of the liner are identical. Iron oxide has been discussed at length, as to its effect on the linings, but its effect in the foundry is much more important and costly. It would not be too much to say that the best thing that could be done would be the elimination of oxidation in the cupola, the price of which is vigilant application of the fundamental principles and painstaking attention to every-day routine.

Discuss Refractory Brick

V. C. FAULKNER, vice president, Institute of British Foundrymen, contributed a paper dealing with refractory materials at a recent meeting of the London branch of the Institute of Metals, at which Dr. G. L. Haughton, chairman of the London branch, presided. Mr. Faulkner's paper is the result of his own experience and contains valuable information of a general character useful to the foundryman. He stresses the point that for use in a furnace a refractory only needs to be excellent at the *business* surface. The backing should be a material of a higher heat conductivity and a space varying in width from ½ to 1 inch according to the size of the furnace should be left between the outer casing and the wall and filled with dry clay to insure insulation. The author endeavored to show that high fusion point apart from chemical desiderata is not the only qualification required in a refractory material. Heat conductivity also is of great importance. If the exposed surface has to resist the whole of the applied heat and is incapable of passing any of it backward it is liable to fail. The grain size of the material is important and the smaller the grain size the better the heat conductivity.

He suggested plastering the brickwork with a plastic refractory which quickly vitrifies. One advantage thus obtained is that this coating is under no appreciable pressure and therefore does not have its melting point lowered from this cause. However, it is essential that plastic refractories should be incorporated and backed with refractories of better heat conducting properties. Plastic refractories contract in drying, and it is necessary to apply them in two coats of about ⅛-inch thick, air-dried over night in each case.

Cementing materials should be kept to a minimum and as far as possible bricks should conform to specified dimensional limits. In this respect, magnesite bricks are perhaps the truest to shape. If bricks of the correct size cannot be obtained it is recommended that they should be ground to size by hand-rubbing with a carborundum brick. The advantage of correctly sized bricks is that they help to keep mass and local pressure on the brickwork to a minimum, since stresses are more evenly distributed. Care should be taken in mixing refractories and a proper stroke and a clean pug mill should be used for this purpose. In theory acid bricks should never be in direct contact with basic brick but according to the author this may be permitted with a 50-ton open-hearth furnace where pressure is an important factor. With small basic furnaces the magnesite fluxing action is seldom apparent.

Coating the brickwork with a plastic refractory, is rendered difficult with British silica bricks which are not burnt at sufficiently high temperatures and which expand on heating, whereas the plastic refractory contracts.

In opening the discussion the chairman stated that there is great difficulty in getting special bricks to correct shape. Dr. S. Smith, of the Royal Mint, pointed out that the lives of furnaces depend upon continuity of working. A question was brought forward as to whether the painting of the bricks with emery dust in plastic form would glaze the bricks and prolong their lives. And if other material than ordinary firebrick was used for aluminum crucible melting. Dr. Gulliver suggested that the effect of pressure on refractories might be to squeeze out that part of the material that had already been fused.

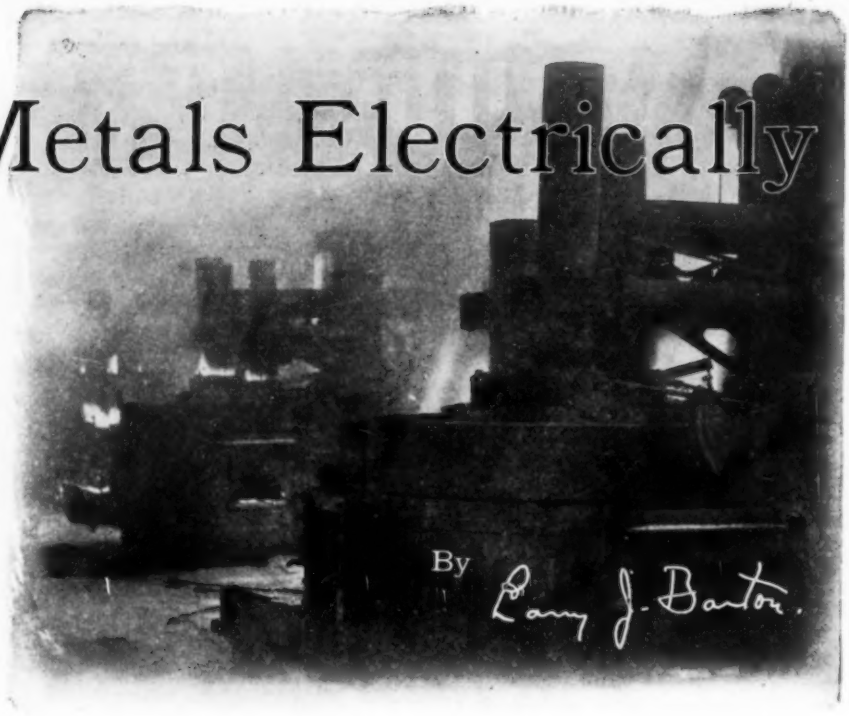
Replying to the several questions Mr. Faulkner stated that the danger of continually heating and cooling a furnace appears particularly between black heat and normal heat. The best method to prevent this danger is to have tight-fitting doors and to obviate any chimney effect. Coating the bricks with emery powder is not recommended, a good material can be obtained by mixing 80 per cent silica sand and 20 per cent clay. Mr. Faulkner stated that he does believe that the melting point of refractories is reduced by pressure; and agreed with Dr. Gulliver that it is possible also that some component part of the brick is squeezed out under pressure. With regard to furnaces for aluminum he suggests building a red brick furnace and coating it with one of the well known plastic refractories. One might also build a concrete furnace as concrete is a plastic refractory. Water-cooling is not practiced in Great Britain but foundrymen practice it exclusively outside Great Britain.

Date Set for Meeting of Purchasing Agents

Purchasing agents throughout the United States and Canada will hold the tenth international convention of their association in Milwaukee, May 25 to 28, inclusive. The general convention committee is preparing for the event. All expecting to attend are requested to inform the general chairman, Walter H. Wenzel, Vilter Mfg. Co., 935 Clinton street, Milwaukee, at once so that the arrangements may be made on a sufficiently large scale to care for all. A large part of the available exhibition space has already been contracted. Information on the exhibition may be obtained from Ole A. Olson, Milwaukee Paper Box Co., 720 South Pierce street, Milwaukee, or W. L. Chandler, Woolworth building, New York. Floyd E. Francis of the Pittsburgh Plate Glass Co., 205 Lake street, Milwaukee, chairman of the hotels committee, requests that hotel reservations be made, directly with the hotels if possible.

Reports received by the department of commerce for its monthly survey of current business show February production in the iron and steel industry was at a higher ratio than in January after account was taken of the fewer working days.

Refining Metals Electrically



Chapter V (Continued)
Heat Treating Special Alloy Castings—Vanadium Tests

CHROMIUM acts like nickel in changing the critical points of steels, but in the opposite direction. It causes the temperatures to become slightly higher than those of plain carbon steels of the same carbon content. Chromium is exactly the opposite of nickel in other properties. Overheating it for prolonged periods, rapidly deteriorates its strength and resistance to shock. For this reason, a double quench gives superior qualities to chromium steels. Chromium steels are capable of taking great hardness, without a corresponding decrease of toughness, this hardness coming directly from the double carbide of iron and chromium. Consequently, all such steels must be softened according to the amount of machining which is to follow.

Fig. 45 shows the changes in the critical temperatures caused by different chromium contents.

The general treatment on chromium steels is similar to that on the alloys containing nickel. It involves a quench from above the critical point, with either a draw back in air, or a reheat and quench at the lower temperature.

An example of the treatment is shown in Table XLIII.

Nickel With Chromium

NICKEL chromium steels probably represent one of the best general types of steel for heat-treated castings. When treated, this metal shows the beneficial result of the toughness and ductility of the nickel, together with the increased hardness and cohesion of the chromium. The best results are obtained by having a certain ratio of the two alloys, generally 2½ parts of nickel to 1 part of chromium, thus giving rise to the common ratios such as 2.50 per cent nickel, 1.00 per cent chromium; 1.50 nickel, 0.60 chrome; 3.50 nickel, 1.25 chrome, etc.

These steels are manufactured by combining the methods used for either plain nickel or chromium steel. If it is remembered that nickel is difficult to oxidize, and chromium is easily oxidized, no trouble should be encountered. Basic operation is preferable, due to its ability to conserve the alloys in the steel. The metal is melted under ordinary circumstances, the alloys being added after the proper slag conditions have occurred.

The same precautions must be followed as in making a plain alloy steel, such as superheating to allow better diffusion of the nickel.

The heat treatment will depend upon the character of the casting, and the results desired. The general treatment is to quench in oil from a temperature higher than the critical point, and draw back to the specification desired. For rigid or high specifications, a double quench is preferred. Quench from about 200 degrees Fahr. above the critical point, requench from just above the critical point, and draw back to the toughness desired. Some figures on these classes of steels are given in Tables XLIV and XLV.

Resist to Impact

THE stress of war gave impetus to the use of molybdenum in steels. The use of molybdenum was associated with great resistance to impact, excellent strength, accompanied by good elongations, and high reduction of area.

However, in the foundry, the use of this metal in steel alloys never has been large, probably from the fact that specifications could be met with more common alloys than for any other reason. Recently, molybdenum has found rather extensive use in large castings, where resistance to shock and great toughness are desired, one particular instance being in the breaking-down rolls for rolling mills.

Its manufacture offers no differences from that of any other alloy steel. Molybdenum has similar properties to nickel, those of being impervious to oxidation. Consequently it may be made in either the acid or basic furnace, the alloys being reclaimed in either process. The additions of the alloy may be made in the form of ferromolybdenum. This may be added at any time after the bath of metal has become thoroughly molten, or in the basic process it may be added in the form of calcium molybdate, in which form it tends to build its own slag. Having a higher melting point than any other alloy, except tungsten, molybdenum requires high pouring temperatures to insure its thorough diffusion throughout the steel. Therefore, additions must be made a sufficient time before the tap to insure the completion of its fusion and consequent solution.

The figures shown in Table XLVI were

Intrigue Interest

CHROMIUM, nickel-chromium, molybdenum and vanadium steel possess through their very names features of unusual interest. The builder of a well known automobile featured molybdenum and by describing the merits it imparted to rolled steel, established prestige for his car. In the accompany article, Mr. Barton outlines the methods of using uncommon alloys and describes the effects of different kinds of heat treatment. Vanadium, through its ability to produce desirable physical properties at low cost is said by the author to have exceptional merit. In the forthcoming article, which is the last of the chapter on alloy steel, other interesting metals will be covered.

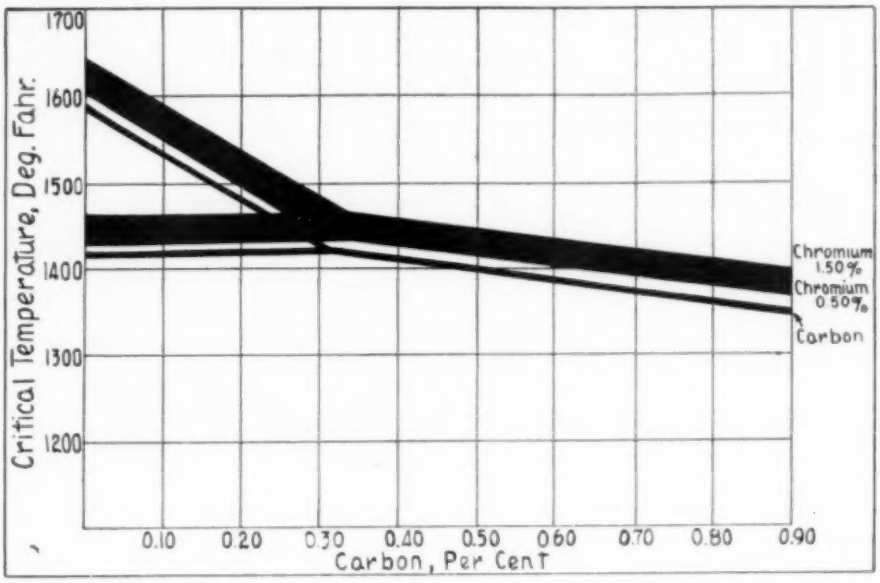


FIG. 45—CHANGES IN CRITICAL TEMPERATURES ARE CAUSED BY VARIATIONS IN CHROMIUM CONTENT

obtained on a casting containing this element:

Steels Carry Vanadium

Vanadium finds rather extensive use in making castings to be heat treated. It is used alone, in combination with nickel or chromium and also with combination of the two. The usual percentage used is sufficient to allow a final vanadium analysis in the steel of from 0.15 to 0.25 per cent, generally running about 0.18 per cent. Steels made with this alloy give exceptional tests both on actual strength and on ductility.

Vanadium will increase the strength and ductility of any grade of steel but there is a considerable difference of opinion as to the exact effect of this element. Some writers make the claim that it is the alloy itself to which these increased figures are due, and explain it by the action of vanadium diffusing the carbidic structure in the steel, giving a refinement of the grain throughout the mass. Other writers make the claim that its worth is strictly one of powerful deoxidizer, stating that its scavenging action manifests itself on oxygen and nitrogen. By removing these gaseous elements, it gives the steel, which is considerably denser than the ordinary product, its increased strength and toughness which is the main reason for the superior tests.

The writer recently has completed a series of tests covering the use of vanadium in cast steel, both on the electric and open hearth furnace. From the results of these tests, vanadium is shown to have no power as a deoxidizer. It gives its superior results by its action on the carbon. The writer made a large number of tests taking analysis for manganese, silicon and vanadium at various points during the heat. It was found that the loss of manganese and silicon increased as the pouring of the heat progressed, while there were no indications of any change in the vanadium content.

It was found that on a 25-ton heat, the silicon loss during the pour ranged from 0.08 to 0.12 per cent, while that of the manganese ranged from 0.04 to 0.08 per cent. However, the vanadium test was constant throughout this period. To obtain 0.18 per cent in the steel it was necessary to add only 0.20 per cent of vanadium. The loss of this alloy averaged approximately 10 per cent and was due to that which was lost through mechanical mixture with the slag. When vanadium is used, it will be found that the recovery of silicon is much higher than in ordinary steels, which in a way gives rise to the oxidizing claims.

The writer found that this was due directly to the proportion of silicon in the vanadium alloy, which amounted to approximately 10 per cent, and when this was considered, the silicon losses were the same as they would be on a soft steel heat. After the proportion of vanadium dropped below 0.15 per cent, the tensile strength and elastic limit is considerably lower, while there appears to be no advantages in running the steel past 0.25 per cent vanadium. With a steel of approximately 0.25 per cent carbon, there is only enough free carbon to take care of this 0.18 per cent vanadium and when vanadium is added above that figure remains in the steel as an inert element, it represents but an added cost with no advantage.

Vanadium is a metal with a higher fusing point than those more commonly used and consequently must be given a slightly different treatment than either manganese or silicon.

In acid and basic, open-hearth furnaces, this alloy was added at the spout using it crushed to the size of ½-inch mesh. In the basic electric furnace, this alloy was added approximately a half hour before tapping, while in the acid furnace it was added directly in the ladle. While this adding in the ladle is not as good a practice as it might be, the acid steel is poured so hot that complete assimilation is assured and no evidences

TABLE XLIV

Average Tests on Nickel-Chrome Steel

The analysis of the metal averaged as follows: Carbon, 0.30 to 0.40 per cent; nickel, 1.30 to 1.70 per cent; chromium, 0.50 to 0.70 per cent. The results cover approximately 100 tests.

Treatment	Tensile strength pounds	Elastic limit pounds	Elongation per cent	Reduction area per cent
Annealed from 1500 deg. Fahr.	66,700	37,000	17.5	25.8
Annealed from 1350 deg. Fahr.	65,000	32,600	30.1	54.3
Quenched from 1500 deg. Fahr., drawn back to 1000 deg. Fahr.	90,000	65,000	23.9	61.6
Quenched from 1550 deg. Fahr., drawn back to 900 deg. Fahr.	84,400	50,050	26.5	57.7

TABLE XLIII

Average Tests on Chromium Steel

The steel analyzed: Carbon, 0.60 to 0.70 per cent; chromium, 0.50 to 0.75 per cent and the other constituents were standard.

Treatment	Tensile strength pounds	Elastic limit pounds	Elongation per cent	Reduction area per cent
Quenched at 1500 deg. Fahr., drawn back to 1300 deg.	79,000	65,500	34.4	66.6
Drawn back to 1050 deg. Fahr.	100,600	94,300	20.1	60.0
Drawn back to 800 deg. Fahr.	114,000	103,400	14.3	54.4

TABLE XLV

Average Tests Nickel-Chrome Steel

The analysis of metal averaged as follows: Carbon, 0.35 per cent; manganese, 0.82 per cent; nickel, 1.95 per cent; chromium, 0.66 per cent; silicon, 0.36 per cent; sulphur, 0.022 per cent; and phosphorus, 0.011 per cent. These results were given in the *Iron Trade Review* of Aug. 23, 1923.

Treatment	Tensile strength pounds	Elastic limit pounds	Elongation per cent	Reduction area per cent
1500 water quench draw back to 1200	130,000	113,300	14.5	29.5
Air cooled	104,750	75,000	21.0	48.3
Furnace cooled from above draw	105,800	92,650	23.5	52.0
1500 water quench, draw back to 1150, slow cool in furnace	105,750	91,700	23.0	52.0
1500 water quench, draw to 1150, quench from draw	107,000	89,000	21.0	51.1
Do. as above	107,050	89,500	23.5	53.9

of segregation were found. If the acid steel was poured rather cold, the vanadium was added to the furnace; being slightly moistened and the slag thoroughly rabbled immediately after its addition. Practically all of the vanadium may be reclaimed from the scrap when melting in the basic furnace and approximately 50 per cent in the acid furnace.

The following tests represent the result of vanadium steel as made in the acid electric furnace. The metal analyzed carbon, 0.30 per cent; manganese, 0.75 per cent; phosphorus, 0.028 per cent; sulphur, 0.052 per cent; silicon, 0.35 per cent and vanadium, 0.20 per cent. The test results follow:

Test Bar No. 1

Heated to 1700 degrees Fahr. Held at temperature 1½ hours. Cooled in air.
Tensile ..... 98,300 pounds
Elastic limit ..... 62,000 pounds
Elongation ..... 24 per cent
Reduction ..... 39.7 per cent
Fracture ..... ½ cup silky

Test Bar No. 2

Same as No. 1, but cooled in furnace.
Tensile ..... 92,250 pounds
Elastic ..... 56,100 pounds
Elongation ..... 25 per cent
Reduction ..... 40.7 per cent

Test Bar No. 3

Heated to 1700 degrees Fahr. Held at temperature 1½ hours. Cooled in air. Heated to 1400 degrees Fahr. Held at temperature 1 hour and 30 minutes. Cooled in air.
Tensile ..... 92,250 pounds
Elastic ..... 60,500 pounds
Elongation ..... 26.5 per cent
Reduction ..... 47.2 per cent

Test Bar No. 4

Same as No. 3, but allowed to cool in furnace after draw.
Tensile ..... 89,150 pounds
Elastic ..... 54,600 pounds
Elongation ..... 27.5 per cent
Reduction ..... 52 per cent

Test Bar No. 5

Heated at 1700 degrees Fahr. Held at temperature 1 hour. Cooled rapidly in air.
Tensile ..... 103,000 pounds
Elastic ..... 70,000 pounds
Elongation ..... 20 per cent
Reduction ..... 36.6 per cent

Test Bar No. 6

Same treatment as No. 5.
Tensile ..... 101,650 pounds
Elastic ..... 69,720 pounds
Elongation ..... 20.8 per cent
Reduction ..... 35.9 per cent

Test Bar No. 7

Heated to 1700 degrees Fahr. Held at temperature 1 hour. Cooled in furnace.
Tensile ..... 92,750 pounds
Elastic ..... 56,500 pounds
Elongation ..... 25 per cent
Reduction ..... 45.4 per cent

A second series of bars was tested. These had the following analysis: Carbon, 0.42 per cent; manganese, 0.93 per cent; phosphorus, 0.025 per cent; sulphur, 0.047 per cent; silicon, 0.32 per cent; vanadium, 0.21 per cent. The results of these tests follow:

Test Bar No. 1

Heated to 1650 degrees Fahr. Held 2½ hours. Air cooled.
Tensile ..... 117,900 pounds
Elastic ..... 81,000 pounds
Elongation ..... 11.5 per cent
Reduction ..... 15.2 per cent

Test Bar No. 2

Heated to 1660 degrees Fahr. Held 2 hours and air cooled.
Tensile ..... 112,000 pounds
Elastic ..... 80,500 pounds
Elongation ..... 12.5 per cent
Reduction ..... 17.7 per cent

Test Bar No. 3

Same as No. 2, but reheated to 1450 degrees Fahr. Held 2 hours and air cooled.
Tensile ..... 98,800 pounds
Elastic ..... 64,500 pounds
Elongation ..... 15 per cent
Reduction ..... 19.8 per cent

Test Bar No. 4

Heated to 1700 degrees Fahr. Held 2 hours and air cooled.
Tensile ..... 110,560 pounds
Elastic ..... 77,250 pounds
Elongation ..... 12.9 per cent
Reduction ..... 18.2 per cent

Test Bar No. 5

Same as No. 4 but reheated to 1450 degrees Fahr. Held 2 hours and air cooled.
Tensile ..... 97,750 pounds
Elastic ..... 65,200 pounds
Elongation ..... 15.3 per cent
Reduction ..... 19.6 per cent

Test Bar No. 6

Forged down to ¾-inch round from a 2-inch square bar before being reheated. Heated to 1660 degrees Fahr. Held 2 hours and cooled in air.
Tensile ..... 106,250 pounds
Elastic ..... 75,800 pounds
Elongation ..... 16 per cent
Reduction ..... 19.1 per cent

Test Bar No. 7

Same as test bar No. 6 but drawn at 1450 degrees Fahr. Held 2 hours and air cooled.
Tensile ..... 98,260 pounds
Elastic ..... 66,260 pounds
Elongation ..... 16.8 per cent
Reduction ..... 20.1 per cent

The fractures from annealing lugs on castings poured from vanadium steel give an extremely fine grain and dense structure. A carbon steel carrying 0.25 per cent carbon with vanadium gives a similar appearance to 0.40 or 0.45 per cent plain carbon steel.

Authors differ as to the proper temperature at which to treat these steels. These range from 1550 degrees to 1900 degrees Fahr. The author finds that a temperature of from 1675 degrees to 1700 degrees offers probably the best temperature for the ordinary soft carbon steels.

As the influence of vanadium becomes better known, its use will increase for equal results may be obtained using this element as with nickel-chrome steels, with the added advantage that the vanadium steel will be considerably cheaper per pound of metal.

TABLE XLVI

Average Tests of Molybdenum Steel

The analysis of the metal was approximately as follows: Carbon, 0.35 per cent; molybdenum, 0.40; nickel, 1.90; chromium, 0.80; manganese, 0.85.

Treatment	Tensile strength pounds	Elastic limit pounds	Elongation per cent	Reduction area per cent
Air cooled from 1450 deg. Fahr.	162,400	130,000	3.5	3.9
Annealed from 1450 deg. Fahr.	140,400	104,000	13.0	24.4
Air cooled from 1450, drawn back to 1250	119,450	90,000	17.0	25.1
Annealed from 1450, drawn to 1250	101,100	60,150	17.5	33.7

Use Oxygen to Thaw Frozen Tap Holes

By Albert Weber

One of the most annoying and vexatious troubles that comes to harass the life of the foundryman in connection with cupola operations is the problem of the frozen tap hole.

A great deal of trouble often is experienced in taking off a heat in the gray iron foundry. Any number of things may go wrong in spite of the best technical knowledge and skill on the part of the operator. Moreover, in accordance with the popular belief that it never rains but it pours, the taphole freezes at the most inopportune time and makes the foundry superintendent tear his hair and wish he had chosen to become a bank president or had adopted some other equally care free profession.

The trouble usually is caused by the carelessness or incompetency of the cupola tenders. In these days when the service of a good cupola tender is at a premium, the following simple method of

INSTALLATION AND CARE OF AIR COMPRESSORS

(*Continued from Data Sheet No.* 566)

STARTING A NEW COMPRESSOR

Fill the cylinder lubricators with the best quality special air compressor oil. Fill the crankcase with the same oil as is used for air cylinders.

In applying the stuffing box packing, the joints in the several rings should be staggered. Fill the box with packing and force in slightly with the gland. It is not advisable to use a wrench in drawing up the gland at first as this will crowd the packing, squeezing out the lubricant, causing the packing to become hard enough to score the piston rod. After the compressor is warmed, tighten the gland just enough to prevent blowing.

The compressor is turned over several times by hand to make sure that all working parts are free when ready to start. The proper direction of rotation always is designated on foundation blue print furnished by the builder. The compressor is not to be brought up to full load immediately, but rather should be operated without load for some time, allowing the working parts to become thoroughly covered with an oil film, and careful observation should be made to detect any undue heating. This can be accomplished by opening a valve in the air line or the two indicator cocks on the side of air cylinders. Turn on the cooling water to the cooling system. In the case of a steam machine, open the drain cocks on the steam cylinder and drain the steam pipe above the throttle valve until it is warmed. Crack open the throttle valve and allow steam to enter the steam cylinder until it is warmed, turning over the compressor slowly. When well warmed, gradually bring up to speed, and throw the load on the compressor slowly. Watch the unloading devices to see that they are functioning properly.

Any asbestos sheet packing is suitable for gaskets between air cylinder and heads. The heat of compression and oil gradually soften rubber packing. In replacing gaskets they should be the identical thickness as furnished by the builder to insure proper clearance between air piston and cylinder heads.

A good grade of leather belting should be used. Keep shaft centers reasonably far apart to give a good arc of contact on pulleys 15 to 20 feet centers and arrange to have slack side of belt on top. Vertical belts are to be avoided if possible. Be sure the belt runs in the center of the pulleys and that it is not

(*Concluded on Data Sheet No.* 568)

INSTALLATION AND CARE OF AIR COMPRESSORS

(*Concluded from Data Sheet No.* 567)

any tighter than is necessary to prevent slipping. A tight belt places a heavy load on the bearings, causing them to heat. It also increases the operating power. The belt should be from ½ to 1 inch narrower than the face of the belt wheel. New belts are stiff and do not adhere to the pulleys like an old belt so that trouble sometimes is experienced in starting a new outfit. A good belt dressing will soften the belt and prevent slippage. Use only a sufficient amount of belt-dressing to obtain softness and pliability. Grease will cause a belt to slip. To overcome such a condition wash it with gasoline and dry the surface with powdered chalk, at the same time absorbing any grease.

The short belt arrangement is ideal for a compressor drive, as there is no initial belt tension and little slippage. When the motor is stopped, the belt has no strain. The idler pulley carried on the arms swung from the compressor frame is free to rise or fall and float on the belt, taking up the slack so that the belt contact with the pulleys is increased rather than the tension. A flexible endless belt always should be used in connection with a short belt drive arrangement.

INSPECTION

Regular inspection should be given the outfit at certain intervals at which time any necessary adjustments may be made, such as replacement of worn parts, new packing, taking up the play in working parts and cleaning air valves and crankcase. Compressor valves are easily removed for inspection. With the correct lubricant, the presence of any deposit on the valves indicates that either the intake air is dirty or that too much oil is being used. Carbon deposits should be removed and a smaller quantity of oil used in the cylinder. All parts and passages should be examined and any obstructions such as carbon and sticky oil removed. The crankcase oil should be renewed at intervals, but before changing the oil, the crankcase should be thoroughly drained and cleaned.

The water jackets should be inspected and washed as often as necessary instead of waiting until the water space is clogged tight with mud and other foreign matter.

THE FOUNDRY DATA SHEET, APRIL 1, 1925

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

Around the World with The Foundry

Little Journeys to the homes of our readers

Brazil

IN BYGONE days many a clipper ship was driven south to the tune of the old deep sea chantey "We're Rolling Down to Rio". The bronzed and hairy crew manned the main braces and tailed aft on the straining deck to take advantage of the whistling *trades* which buried her lee rail under and threw up a boiling wave of clear white foam on either side of her glittering copper forefoot.

Brazil's commerce has grown with the years until now she supplies more than 60 per cent of the world's coffee and more than 50 per cent of the total supply of crude rubber, but the stately ships with their clouds of billowing white canvas together with their hard driving and dare devil skippers long since have passed to the haven under the hill. The ships that now go down to Rio are big and bluff and red as becomes ocean tramps that roam the seven seas and they take on cargoes at Rio Janeiro, Para and Pernambuco, cargoes of coffee and rubber, mahogany and rosewood, sugar and tobacco, cotton and cocoa.

More of an agricultural than a manufacturing nation the greater part of the machinery used in the country is imported. A complete survey of the casting industry is not available, but of the 41 foundries listed 9 are on the subscription list of The Foundry and are guided in their foundry practice by the world's greatest authority on matters pertaining to the moulding and casting of metals.

"Wherever metals are cast you'll find THE FOUNDRY"

thawing a frozen tap hole will be appreciated.

Under the old method, every time the tap hole freezes it has to be opened with chisels and a sledge—a slow, laborious method which often ends by damaging the breast and making it almost impossible to continue the heat. Some years ago a new method was tried and proved so satisfactory that it has been adopted as standard.

A tank of compressed oxygen with about 20 feet of ¼-inch hose attached to it was placed near the cupola. The other end of the hose was inserted in a 4-foot length of ¼-inch gas pipe, which had been bent in such a manner that the cupola tender from his station could handle it conveniently. A ¼-inch rod was heated by inserting it in the cupola through the tuyere peep hole. The rod then was placed against the frozen tap hole. The compressed oxygen was turned on, the 4-foot length of gas pipe which formed the torch was held against the tap hole and instantly ignited the gas. The flame was held against the tap hole until the frozen metal had thawed after which the torch quickly and easily ate a hole through to the white hot metal lying in the well of the cupola.

When the molten metal started to run it quickly cut away the frozen metal at the sides and enlarged the tap hole to its original size. The whole operation required only a few minutes, caused no damage to the breast and hardly interrupted the pouring operations on the floors.

Book Review

Proceedings of the American Society for Testing Materials covering the twenty-seventh annual meeting, 1924. In two parts. Part I, 1173 pages. Part II, 1133 pages, cloth, 9 x 6 inches. Published by the American Society for Testing Materials, Philadelphia and supplied by THE FOUNDRY; price each part, $6.50 in paper, $6.50 in cloth, and $8.00 in half leather binding.

Part I contains the annual reports of 35 standing committees of the society, together with the discussion thereon at the annual meeting. Reports are included of committees on ferrous and nonferrous metals, cement, ceramics, concrete, gypsum, lime, preservative coatings, petroleum products, road materials, coal and coke, waterproofing materials, electrical insulating materials, shipping containers, rubber products, textile materials, thermometers, methods of testing and nomenclature and definitions, 87 tentative standards which have either been revised or are published for the first time; annual address of the president and the annual report of the executive committee. It also contains three reports of the joint committee on investigation of phosphorus and sulphur in steel, effect of sulphur on endurance properties of rivet steel, metallographic investigation of effect of sulphur on rivet steel and structural steel, and the report of the joint committee on standard specifications for concrete and reinforced concrete.

Part II contains 47 technical papers with discussions. These include valuable information on results of investigations by experts in the field of engineering materials. This part also includes a symposium on effect of temperature upon the properties of metals and a symposium on corrosion-resistant, heat-resistant and electrical-resistance alloys. These symposiums include valuable new and hitherto unpublished data.

Lists Foundry Supplies

The Shanafelt Mfg. Co., Canton, O., recently has published an illustrated catalog describing the many products of the company which include chaplets, cements for repairing castings, foundry nails, gaggers, brushes, pattern letters and figures, fillets, rapping plates, dowel pins and plates, fasteners, shellac, pattern wax, steel flasks, snap flasks, etc. The catalog is exceptionally well illustrated and the information given covers a wide range.

The Holland Furnace Co., Holland, Mich., manufacturer of warm air furnaces has leased for a term of years the main floor of 449 Central avenue, Newark, N. J., for use as a display room. The company also has arranged for a warehouse in the Shupe terminal at Kearny, N. J.

To House Exhibition in State Fair Buildings

SYRACUSE, N. Y., the city selected for the 1925 convention and exhibition of the American Foundrymen's association, is experienced in handling large crowds, since it is the home of the New York state fair, one of the largest undertakings of its kind in America. The fair grounds, located on the western border of the city, consist of 100 acres of land on which are built many buildings. Practically 100,000 square feet of exhibition space is available, which will be used for the display of foundry equipment, the technical sessions also being held at the fair grounds. The exhibits will be in manufacturers' and liberal arts building and the dairy building and colonnade, the latter being shown in the accompanying illustration.

The Erie and Oswego canals meet practically in the center of the city, while the community is known as a railroad center. In the early history of the city, the manufacture of salt from the salt springs was the chief industry, half of the population being engaged in this occupation. However, the decadence of this field caused attention to be given to the development of other manufacturing industries. The city is well represented in the iron and steel industry, 25 foundries being located in the city.

Canadian Company *Produces Large* Electrical Castings

By Pat Dwyer

ONE of the most picturesque careers of the many presented by captains of industry who have made America a synonym for pioneering achievement in the mechanical arts was closed on March 12, 1914 in the city of New York when the exceedingly active brain of George Westinghouse at last was stilled in death. However, the vast manufacturing establishments which in the course of time had been erected and equipped to convert his ideas into tangible form had attained to such proportions that they were quite competent to carry on even without his personal guidance. In addition to providing the reason for the existence of a manufacturing plant, he also built up an operating organization that practically is self perpetuating.

Few inventors have been so prolific of ideas and even a smaller number have lived to witness the practical application and success of these brain children, or have achieved the measure of worldly success that crowned the efforts of this young mechanic who made the first application of the airbrake before he was 24. A boundless energy that carried him while a youth between the period of school and college, into the Civil war, where he served first in the cavalry and later as an engineer in the navy, carried him in after years far along the road of applied science and mechanics. Between his 34th and 44th years he is credited with taking out 134 patents, an average of over one a month.

Many of these patents were based on mechanical appliances involved in his development of the airbrake, methods for the distribution of natural gas, development of equipment and methods for the application of alternating current, the air spring and the geared turbine.

The first little plant built in 1886 in Garrison Alley, Pittsburgh, furnished employment for 200 persons. When Mr. Westinghouse died in 1914 his one time modest little company was capitalized at $200,000,000 and between the plants in America and foreign countries gave employment to 50,000 people. At present the Westinghouse Electric & Manufacturing Co. manufactures many thousand different electric and steam machines and machine parts. The products range in size from a lady's curling iron through various sizes of motors, generators, steam turbines and transformers up to electric locomotives that weigh 275 tons and which are capable of replacing steam locomotives at any point where electric current is available.

Twenty-eight years ago in Oct. 1896, the company erected a manufacturing plant at Hamilton, Ont., which through natural limitations resembles in many respects the plant in East Pittsburgh when it was opened in 1904. In recent years the operations of the company in the United States have been specialized to an extent that each plant concentrates in the production of a definite line of equipment. For example, one makes nothing but airbrake equipment, a second manufactures stokers exclusively, a third makes motors and motor frames and a fourth specializes in turbines and auxiliary equipment.

The tremendous industrial market afforded by the United States and foreign countries is sufficient to absorb the output which amounts to approximately 58 carloads a day. Conditions are different in Canada where the plant only caters to the wants of the Dominion. The natural result is that while the iron foundry and the nonferrous foundry are devoted exclusively to the production of castings for Westinghouse machinery, the number of castings ordered from any individual pattern is limited and repetition methods in vogue in other plants of the company are not applicable. In many respects the foundry is operated in the same manner as that of any large machinery jobbing foundry. For several years the gradual expansion of the plant has taxed the foundry beyond its capacity and this has resulted in a crowded condition that was not contemplated in the original plans. A new foundry recently has been erected and placed in operation at the opposite end of the city from the present plant and has been designed and equipped in an adequate manner to take care of present and future expansion.

The old foundry is laid off in a manner that may be regarded as standard or typical of American foundries in that the building is divided into three main bays by two rows of steel columns. The columns serve the double purpose of supporting the monitor roof that extends the full length of the building, also the main crane runway and a second runway at a lower level for a traveling wall crane. The 20-ton and 30-ton crane in this bay together with the 5-ton wall crane and an additional 10-ton traveling crane in one of the side bays were supplied by the Northern Engineering Works, Detroit.

Castings varying in weight from a few hundred pounds up to 30 tons are molded and cast in the center bay. With the available crane and melting equipment, heavier castings conceivably might be handled, but since the castings usually present a comparatively thin section and therefore a corresponding large bulk, the limitations of transportation facilities, automatically limit the weight of the individual pieces. This point will be appreciated more readily by referring to the assembled generator set for a hydraulic installation shown in the illustration Fig. 7. The diameter of the main frame is over 30 feet and although

Fig. 1—A dry sand basin at the end received the metal from a 25-ton ladle and conducted it into a long curved runner

it is made up of three parts joined by vertical flanges, and although each part weighs approximately 25 tons, still it is apparent that each section constitutes a difficult load to handle and transport. Each of these machines is asembled in the erection shops of the company, then separated into many units, the number of units depending somewhat on the ultimate destination of the device, and finally shipped with the units marked in a suitable manner to facilitate the work of the erectors at the water power site.

The foundry office is located at the far end of the bay partly shown to the left in Fig. 2. The remainder of the floor space in this bay is laid off in a number of molding floors which extend from a gangway close to the columns back to the side wall of the building. Small and medium weight castings are made in this bay, many in wood flasks, but the greater number are made in iron and steel flasks. Molten iron for this section is conveyed in buggy ladles operating over a narrow gage track connected by turntable to a second track set at right angles to the first and extending across the center bay to a point in front of the cupolas.

Small molds are made on approximately one-third of the floor space in the second side bay. The remainder of the space is occupied by the melting and coremaking departments. Iron is melted in two cupolas made by the Whiting Corp., Harvey, Ill., one lined to 72 and the other to 36 inches. The stock for the cupolas is conveyed to the platform by an elevator and is charged into the cupolas by hand. The daily average heat, sometimes melted in one and at other times in both cupolas, is 35 tons. The two cupolas provide greater flexibility where several mixtures are poured on the same day. In this connection it may be of interest to note that the heaviest heat poured to date, 102 tons, was melted entirely in the 72-inch cupola. The average weight of good castings produced per man per day is 900 pounds.

Castings in Three Classes

A charge of 3000 pounds of iron is used in the large cupola, while the iron for the small cupola is charged in 700-pound lots. The iron to coke ratio varies from 1 to 8.50 on small heats where both cupolas are employed, to 1 to 11.49 on large single heats in the large cupola. In the illustration, Fig. 6, one of the side floor buggy ladles is shown under the spout of the small cupola, while a 25-ton ladle is being filled at the same time under the spout of the large cupola. Special mixtures are made up from time to time to meet special conditions, but usually three standard mixtures are employed and the castings are grouped in three general classes according to their average thickness of metal. The first class includes all castings under ½-inch, the second class covers castings between ½ inch and 2 inches and the third class takes in all castings that exceed 2 inches in thickness.

Castings for the perforated frame shown in Fig. 7 are typical of the large number classified as medium, that is in which the metal thickness is less than 2 inches. The thickness as specified on the drawing is 1½-inches, but occasionally the mold strains to some extent and the casting exceeds anticipation in weight and thickness. An addition of 10 per cent steel is made to the iron mixture from which these castings are poured. The analysis of one of these castings which approximates closely that of others in the same class follows: Silicon, 1.80 per cent; sulphur, 0.079 per cent; phosphorus, 0.50 per cent; manga-

nese, 0.62 per cent; total carbon, 3.28 per cent, graphitic carbon, 2.65 per cent; combined carbon, 0.63 per cent.

Results of tensile tests on this metal are not available, but the transverse breaking strain on the regular 1¼-inch diameter bar varies between 3500 and 4000 pounds, the deflection is between 0.11 and 0.14 inches, the brinell hardness is 217. From the foregoing it may be noted that the classification of the castings and the specifications to which they are supposed to conform, parallel close-

FIG. 2.—THE CROWDED CONDITION OF THE FOUNDRY WHICH EVENTUALLY WAS RESPONSIBLE FOR THE ERECTION OF A NEW SHOP MAY BE NOTED IN THIS ILLUSTRATION OF THE MAIN BAY

ly these same features as laid down by the American Society for Testing Materials.

The remainder of the space in the second side bay beyond the cupolas is occupied by the coremaking department. When necessary, some of the work in this department overflows into the main bay of the foundry. In fact large cores of various kinds enter so extensively into the preparation of molds that at times it is difficult to determine just where coremaking leaves off and where molding begins. This point will be developed more in detail later in a description of the methods employed in making some of the large molds.

Extensive Core Department

Sand for the cores is prepared in a mixer of the muller type. Several mixtures are employed to conform to the widely varying size and shape of the castings. Beach sand in varying degrees of fineness is obtained from the shore of the bay which extends in a semicircle around the city.

Small cores are made from a fine grade of sand, bonded with oil. Medium size cores, designed to occupy positions where they are almost entirely surrounded with iron are made from a coarse grade of beach sand bonded with a pitch-base binder. Cores that are not subject to such severe service are made from a mixture of new and old sand in varying proportions. Large cover cores and other cores designed to be assembled in groups to form all or nearly all of any given mold, are made entirely from old sand bonded with a pitch-base binder in the proportion of 1 part of binder to 30 sand. Cast-iron arbors, made in open sand beds maintained for the purpose, are used to reinforce the cores. The extent to which cores are employed is reflected in the tonnage reports which show that approximately 15 per cent of the iron melted is absorbed by the arbors.

Large cores are dried in a coke fired oven, 8 x 12 x 22 feet. The track from the oven extends into the main bay of the foundry, thus facilitating loading and unloading the large cores directly by one of the traveling cranes that serve this part of the building. Old core sand, intended for use again, is kept in a pile near the end of the bay in which the cores are made and in close proximity to that part of the main bay in which the castings are stripped and cleaned. Refuse sand and other rubbish is loaded directly into railroad cars on a spur that enters the building at this end. The material is used to fill low lying parts of the company's property.

Details of the manner in which large and medium size generator frames are molded are shown in several of the accompanying illustrations, particularly Figs. 3, 4 and 5. The pit in which the largest mold of Fig. 5, is made is 10 feet deep, 17 feet wide and 32 feet long. The sides and ends are lined with cast-iron plates, but the bottom is formed of clay covered with a layer of cinders. A pump is employed constantly to keep the bottom of the pit free of water that seeps through the soil. A heavy, cast-iron foundation plate, conforming approximately to the shape of the casting and provided with lugs on the outer and inner sides, serves as a base on which to build the mold and also as an anchor for the binder bolts that hold the various parts of the mold together.

On a recent order for 16 complete power units, this pit was used continuously for the production of 48 segments. Preparation of the first mold involved considerable time, but the remaining molds were assembled rapidly. The molders began with the empty pit and had to build the back wall and bottom and afterward dry them, together with the superimposed coating of loam. This wall and bottom, with slight patching, served for all the subsequent castings. A new set of cores to form the inside face of the cast had to be made for each succeeding segment.

More than usual care was exercised in the preparation of the first mold, not only to secure a true and accurate casting, but also to insure a minimum amount of work on each of the molds destined to follow. After the foundation plate was adjusted properly, level and solid, it was covered with a single

course of brick laid on edge and with the joints filled with fine cinders. The brick was covered with a 1-inch thickness of loam which later was scraped down to a true and level surface with a straight sweep attached to a long arm which in turn revolved through an arc of approximately 130 degrees around a spindle erected near one side of the pit at the center. The mold was for a 1/3-section of a circle, therefore it is apparent that the space required for the swinging arm with sweep attached is little over one-third of a circle at the outer extremity. A little extra space was required at each end for the large rectangular slab core that formed the outside face on the vertical flange designed for bolting the segments together later.

Dried the Mold

A vertical sweep with a shoulder at the top was employed, first as a guide in building the back wall, and later in sweeping a coating of loam over the face of the brick. The radial lines at each end of the arc were laid off by actual measurement and the end of the wall was finished in a straight line to coincide with the end core. Coke baskets were placed on the inside and on the outside of the wall and the mold was covered with corrugated sheets until the wall of the mold was dried thoroughly. On subsequent molds no fire was required on the outside. The space between the brick wall and the back wall of the pit was rammed full of sand after the first mold was closed and this sand was not disturbed afterward.

The inside of one of the castings is partly shown in Fig. 2, at the extreme right. It may be noted that it presents a great many vertical ribs connected by a flange top and bottom and by three horizontal ribs. This part of the mold is formed of dry-sand cores assembled on the flat bottom of the mold and built up in tiers.

Openings in the face of the casting which form such an interesting feature in the illustration in Fig. 7 are made in the mold by a number of slab cores nailed to the outside face of the mold. They are located in place by a templet. The templet and the manner in which it is applied are shown in Fig. 5 where one of the molds is partly cored. A stack of slab cores for the remaining space on the face of the mold may be noted in the bottom of the mold near the center The large cores for forming the inside face of the mold are jammed hard against these flat *window* cores and in that way the thickness of the wall of the casting is determined.

After all the cores were set in place, the open space on the top of the mold was covered by a loamed plate corresponding in general features to the foundation plate on which the mold was built. This plate was provided with openings for the pop gates and risers and with lugs for the reception of the anchor bolts extending from the top to the bottom plate. The space between the assembled cores and the wall of the pit on the spindle side was rammed full of sand designed to hold the cores in their place. A dry-sand runner basin was placed above one end of the mold and this served to feed a long, curved, continuous runner that extended almost to the far end of the mold. Iron was poured from a single, 25-ton ladle brimming full and entered the mold through a row of small pop gates that insured an even distribution of the metal at an approximately uniform temperature, to all parts of the mold. The contraction feature is of major importance and had to be anticipated on account of the shape

Fig. 5—Above—Large frames are made in 1/3 segments in a loam mold built on a foundation plate in a suitable pit in the floor. The interior of the mold is made up with cores in the same manner as the molds for one-piece castings

Fig. 3 — Below — Inside face of a one-piece frame formed by a number of dry sand cores built up in tiers. Fig. 4—Right—Molds for one-piece frames are rammed in pits in the floor. A segment pattern is employed first and is followed by a sweep

FIG. 6—IRON FROM THE SMALL CUPOLA IS TAPPED INTO A BUGGY LADLE THAT SERVES THE LIGHT FLOORS. THE LADLE SHOWN UNDER THE SPOUT OF THE CUPOLA TO THE LEFT IS EMPLOYED TO POUR HEAVY CASTINGS IN THE MAIN BAY

and size of the casting. One risk was eliminated by filling the mold with iron at a uniform temperature. Insurance against a second risk was taken by removing a row of cores from the center after the casting had set. Shortly after the casting was poured, the binders were released so that the casting might encounter a minimum of resistance in following the natural law of contraction.

In lifting the casting out of the mold, slings were attached in such a manner that the casting tipped in and away from the vertical brick wall. By observing this precaution, the face of the mold was not disturbed and with a little patching each time served for the entire series of castings.

Smaller frames are made in the floor in green sand or skin dried molds depending on the size of the casting. One of these molds for a 7½-ton casting is shown, partly made, in the illustrations Figs. 3 and 4.

Employ Segment Pattern

In many respects the equipment and methods used in making the mold in loam also are employed in making the mold in sand. A foundation plate is leveled on the bottom of a pit. It is provided with a spindle seat in the center and with a suitable number of lugs on the outside to serve as anchors for the binder bolts. A sand bed is swept level above the plate and then a segment of a ring is employed as a pattern to form the vertical wall. The sand is rammed against the segment and reinforced with rods laid horizontally in tiers about 6 inches apart. Standards are erected from the bottom plate at suitable points to engage binder bars or an iron cope after the mold is assembled. The standards are designed to support the bars or cope and prevent them from crushing the walls of the mold when the binder bolts are screwed down. This precaution is observed on all large jobs.

The segment shown in Fig. 4 embraces a little more than one-third of the circumference and is shifted three times while the ramming of the wall is in progress. It is held in place by the spindle in the center and also by suitable braces at the back, but owing to the manner in which patterns distort under the pressure of rammed sand, a sweep is employed after the segment is removed for the last time, to true up the face of the mold. After the face is finished, it is blacked and slicked. A coke basket is lowered into the mold which then is covered with thin steel sheets and allowed to stand until the face is dried back for from 1 to 4 inches depending on the size of the casting. Usally the mold is dried over night.

Part of the set of cores for forming the inside of the casting is shown in place in Fig. 3 and another set is shown in the left background of the illustration Fig. 4. The cores are placed in the mold in the same manner as the cores are placed in the loam mold. A number of flat segment cores are employed instead of a loamed plate to cover the mold. The entire assembly is covered with a large iron cope or with a number of plates and binders. If a cope is employed it is rammed full of sand and a number of small pop gates are arranged in a ring over the mold and filled from a circular basin.

Describes Products

The line of power transmitting machinery manufactured by the W. A. Jones Foundry & Machine Co., Chicago, is described in a 450-page catalog just published. The equipment described includes gears and speed reducers, pulleys, friction clutches, power transmission equipment, sprocket wheels and chain belting, and miscellaneous appliances. The various types of equipment are illustrated and tables give dimensions and sizes. Views of the pattern shop, foundry, tool room and machine shop also are given.

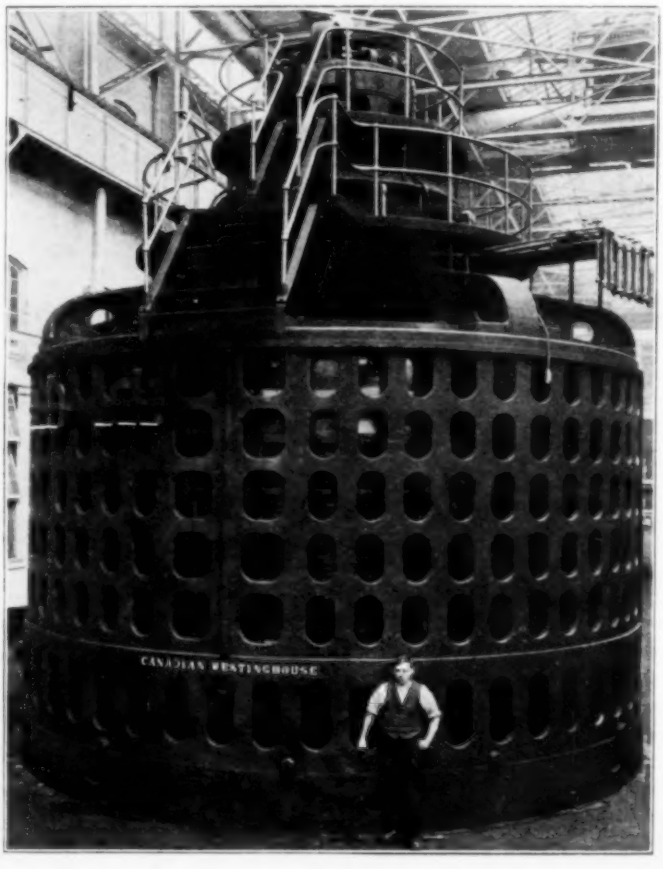


Fig. 7—Many large castings enter into the construction of this generator which has a rating of 55,000 kilovolt amperes. The unit is shown as it appeared assembled on the floor of the erection shop

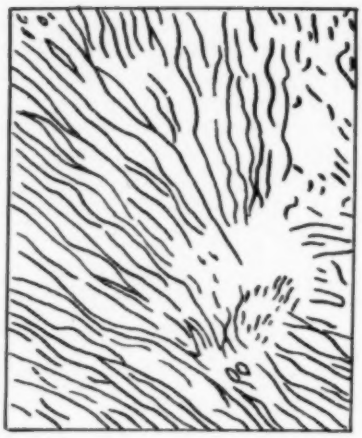
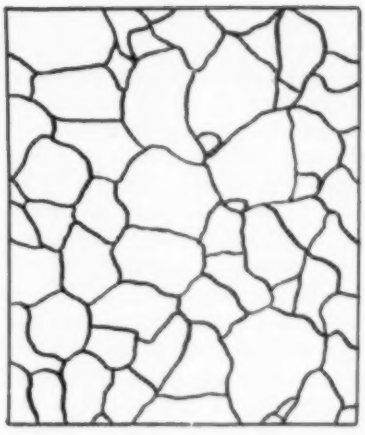


Fig. 1—Left Structure of Pearlite or Iron Carbide FeC_3. Fig 2—Right—Structure of Ferrite or Pure Iron



Carbon Control Gages Strength

By James Ward

WITHIN the last two years the attention of American foundrymen has been directed toward the new German product, pearlitic cast iron. The process for making this metal was patented by Diefenthaler and is contained in American patent No. 1,502,983. Among the properties claimed for this iron are high tensile strength, ready machinability, ability to withstand a certain amount of deformation and considerable capacity for resisting shock. It also is claimed that smaller risers are needed in casting the metal. Pearlitic iron is essentially a gray iron of special analysis cast under special cooling conditions. Clear understanding of the nature and properties of this metal necessitates consideration of its structural make-up.

Pearlitic iron, in the broader sense, is not new in America. The nature and production of pearlitic irons have been known for many years. The pearlitic iron of the Germans is not merely a pearlitic iron, but is a special pearlitic iron of low carbon content.

Pearlite was given its name by the late Prof. H. M. Howe. This investigator noted the resemblance of the iridesence of the lightly etched surface of a carefully polished sample of an annealed 0.90 per cent carbon steel to the sheen of mother of pearl. Structurally speaking, pearlite is the laminar eutectoid of ferrite or structurally pure iron and cementite. The chemical term is iron carbide, represented by the formula Fe_3C.

When examined under a high power miscroscope, an annealed and etched 0.90 per cent carbon steel is seen to consist of innumerable thin layers or laminae as shown in Fig. 1. Metallographists have found that these layers consist of alternate strips of ferrite and cementite, in the ratio of 87 parts ferrite to 13 parts cemenite, or 0.90 parts carbon to 99.10 parts of iron. The term eutectoid indicates an intimate mixture of constant composition formed at a definite temperature in the solid state with the evolution of heat, and referred to as energy transfer. Below 0.90 per cent carbon, free ferrite makes its appearance and surrounds the grains of pearlite. At zero carbon the iron is wholly ferritic as shown in Fig. 2. These changes are indicated in Fig. 3. Above 0.90 per cent carbon free cementite is found. In steel this cementite is found surrounding the grains of ferrite. In cast iron it is found as eutectic cementite in ledeburite and in hypoeutectic cementite, this latter form usually being found as dendritic formations.

Note Similar Structure

Gray cast irons are related closely to steel in their structural make-up. Steel under 0.90 per cent carbon is ferrite and pearlite. Gray iron under 0.75 per cent combined carbon has a matrix of ferrite and pearlite, the remainder of the carbon occurring as graphite flakes. Cast irons containing about 0.75 per cent combined carbon are pearlitic irons. The amount of carbon required for the eutectoid in gray iron is less than that required in steels, since the iron matrix occupies only about 90 per cent of the volume graphite occupying the remainder. Thus if the matrix is 0.90 per cent carbon at eutectoid composition, the sample may average 0.80 per cent combined carbon.

All high test irons are pearlitic or nearly pearlitic but the converse is not true. Irons of high graphite content or having coarse grain structure may have a pearlitic matrix, yet be weak. These facts were pointed out a number of years ago by Prof. Howe and by Prof. Sauveur.

The German product owes its properties to the combination of pearlitic matrix, low carbon, hence low graphite content, and small grain size. The specified analysis is as follows:

	Per cent
Total carbon	2.80 to 3.00
Graphite	1.95 to 2.15
Combined carbon	0.75 to 0.85
Silicon	0.80 to 1.00
Manganese	0.70
Sulphur	0.10
Phosphorus	0.40

It is seen readily that this is not an analysis of common cupola iron. The total carbon content is lower than that ordinarily attained in the cupola. This analysis is specified for light sections, yet the silicon is quite low. This necessitates pouring the metal into heated molds. A pearlitic matrix is formed as indicated by the combined carbon. The graphite is low and the grain size small. The manganese, sulphur and phosphorus are in similar proportions as found in ordinary American practice.

The brinell hardness is around 180, the same as produced by strong American irons. The tensile strength given is about 25 per cent higher than that of the best grades of high test iron. The most striking difference in properties is revealed in the alternating impact test, the pearlitic iron apparently having over three times more resistance to shock than found in the better grades of ordinary iron.

The foregoing explanation indicates the structure and some of the properties claimed for pearlitic irons. The following remarks and comparisons point out the limitations of the process and some comparisons with ordinary practice.

Uniform pearlitic irons cannot be produced in heavy sections because of the differences in cooling rates at

various depths of section. Uniform cooling is essential to uniform structure, and this condition cannot be obtained in heavy sections. The best pearlitic iron is said to be crucible metal, cupola metal being inferior. By correct cupola practice and proper mixtures, it is possible to produce iron in sections up to 1-inch which will average 40,000 pounds tensile strength. Such iron will have carbon 3.0 to 3.20 and silicon 1.0 to 1.4 per cent. If crucible or air furnace iron must be used and poured into special heated molds to obtain 25 per cent increase in strength, a big price is being paid for a moderate advantage in strength. For many castings it is possible to produce great strength and wear resisting properties at much lower cost, namely through simple heat treatments.

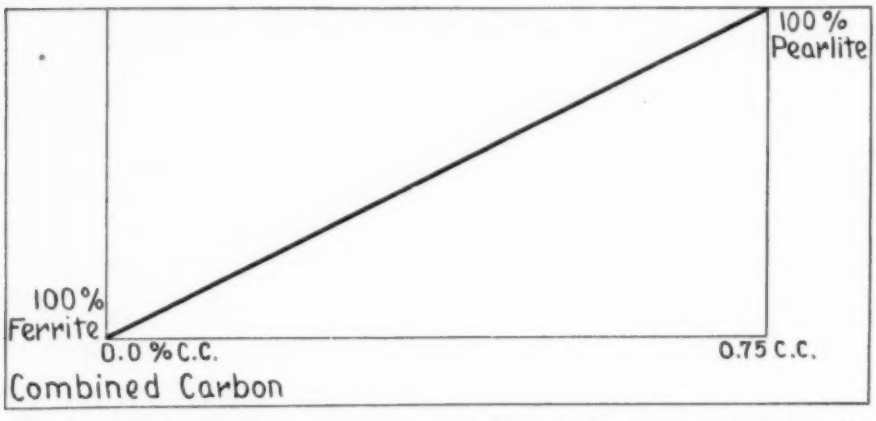


FIG. 3—DIAGRAM SHOWING THE CHANGE FROM FERRITE TO PEARLITE—CARBON RANGING FROM 0.0 TO 0.75 PER CENT

Pearlitic iron is not a soft iron in the sense that this term is used by jobbing foundries. It readily is machinable, but is tough and cannot be hogged. In machinability it offers no advantages over ordinary high test irons. The use of smaller risers is an advantage which is gained largely through the process of heating the mold. Ability to withstand shock and deformation are interesting properties. It would require familiarity with all the intimate details of these particular tests to enable intelligent comment. It should be noted that phosphorus is fairly low. This tends to raise the values for deflection shock and machinability. German foundrymen evidently have not the phosphorus preferences of the English foundrymen. Little stress is laid on the sulphur content. The gospel of sulpher network has made little impression in Germany.

The practice of heating molds is an old one, but generally has been used for the purpose of making a soft or ferritic casting. In this case the iron would be close gray if poured into a green mold, while more complete graphitization and retention of small grain are attained in the heated mold. The writer notes the British patent to H. Lantz for producing high strength iron in a heated mold. Pearlitic iron should resist deterioration from heat better than most irons, because of its low carbon and silicon content. Cast mottled iron may be graphitized to a pearlitic matrix and produce high strength.

Pearlitic iron is no mysterious product destined to revolutionize the foundry industry. It is a high grade metal produced under rigidly specified conditions, sometimes almost on a laboratory basis. The principles underlying its manufacture have been understood for many years by American metallographists.

Variety of Papers Read

At the annual meeting of the Institute of Metals held March 11 and 12 in the hall of the Institute of Mechanical Engineers, London, England, the following papers were presented and discussed: H. T. Angus and P. F. Summers, "The Effect of Grain Size Upon Hardness and Annealing Temperature"; S. L. Archbutt, "A Method of Improving the Properties of Aluminum Alloy Castings"; G. L. Bailey and R. Genders, "The Density and Constitution of the Industrial Brasses"; T. G. Bamford, "Comparative Tests on Some Varieties of Commercial Copper Rod"; E. A. Bolton, "The Removal of Red Stains from Brass"; Denis Bunting, "The Influence of Lead and Tin on the Brittle Ranges of Brass"; Ulick R. Evans, "Surface Abrasion as a Potential Cause of Localized Corrosion"; J. Newton Friend and J. S. Tidmus, "The Influence of Emulsoids upon the Rate of Dissolution of Zinc in Solutions of Lead, Nickel and Copper Salts"; R. Genders and G. L. Bailey, "The Alpha Phase Boundary in the Copper-Zinc System"; Prof. Kotaro Honda and Prof. Ryonosuke Yamada, "Some Experiments on the Abrasion of Metals"; Prof. Tominatu Isihara, "On the Equalibrium Diagram of the Aluminum Zinc System"; A. L. Norbury, "Note on the Effects of Certain Elements on the Electrical Resistivity of Copper"; Sir Thomas Kirke Rose, "Density of Rhodium."

Issues Bulletin on Fuel Gas Analysis

"The Analysis of Fuel Gas" is the title of a bulletin prepared by S. W. Parr, professor of applied chemistry, and F. E. Vandaveer, research graduate assistant in gas engineering, University of Illinois and published by the University of Illinois, Urbana, Ill.

The booklet gives an outline of procedure for gas analysis and the apparatus used for fuel gas analysis as well as the preparation of reagents, manipulation of apparatus and the determination of carbon dioxide, illuminants, oxygen, carbon monoxide, hydrogen, methane and ethane. The appendix gives the different methods of fuel gas analysis such as fractionation by low temperature, optical, absorption and combustion methods. Various calculations of gas analysis are made and typical fuel gas analysis are recorded.

Change in Management

Ferrand P. Hall has been appointed district sales manager in charge of the sales organization and branch warehouse at Cleveland of the Carborundum Co., Niagara Falls, N. Y. Mr. Hall succeeds John MacArthur, who has been district sales manager at Cleveland during the past 5 years. Mr. MacArthur has been assigned to special sales service work and will be located at the main office of the company at Niagara Falls. The appointments are effective April 1. Mr. Hall joined the sales force in 1914 as salesman covering the territory in and about Montreal and the Maritime Provinces. From 1916 to 1922 he was engaged in the retail hardware business and returned to the Carborundum Co., in 1922. Mr. MacArthur has been a member of the sales force since 1909, having been appointed to the sales staff of the Boston, Mass. branch warehouse of the company in February of that year. In January 1919 he was made district sales manager at Cleveland.

W. S. Race has become associated with Miller-Hurst Corp. Detroit, foundry and industrial engineers. Mr. Race was formerly with the United States Rubber Co., having worked in their New York and Detroit offices.

How and Why in Brass Founding

By Charles Vickers

Used Scrap in Manganese Bronze Castings

Will you advise us as to the amount of good, clean scrap that may be used in the manufacture of manganese bronze castings, and rolled sheets?

The only sort of scrap metal that should be used in making such an alloy as manganese bronze is rolled material that contains no added lead. Cast scrap can be used to advantage only when home made and without lead. Scrap bought in the market and designated as foreign scrap is of too uncertain a composition to be worked to advantage. Such material as 70/30 sheet brass and also other formulas such as 60/40 can be used in making manganese bronze. It is a source of copper to the fullest extent of the copper requirements. A chemical analysis of such scrap is essential.

The zinc content must be raised to a minimum of 40 per cent. The iron, and manganese are added in the form of a hardener, and the aluminum that is used in the case of the cast metal may be added separately. Rolled manganese bronze frequently is made without aluminum.

Castings Resist Action of Sodium Chloride

We are making castings of aluminum that are expected to contain salt, and we find that in a short time this container becomes badly corroded. What alloy can we add to the aluminum to make it salt resisting? In another type of casting, the aluminum must withstand pressure to the extent of 100 to 150 pounds per square inch. When the casting are tested under water pressure they leak. What can we add to this metal to make it stand pressures? In both cases we are using a standard No. 12 alloy.

Common salt or sodium chloride is an active chemical where metals are concerned because it is sufficiently hydroscopic to attract sufficient moisture to promote attack on metals. Salt is the source of chlorine and hydrochloric acid gas, both of which strongly attack aluminum. Therefore, salt is a difficult substance for aluminum to resist. However, rolled aluminum seems to resist it quite well, from which it follows that if these containers could be cast of pure commercial aluminum they would have a greater chance of resisting the salt, and especially so if the interior of the container could be burnished, or hammered to densify the metal structure.

The No. 12 alloy is no longer considered a standard as it has yielded largely to the more easily cast silicon-aluminum alloys, with and without copper. No. 12 alloy is not suitable for resisting water pressures as its structure is too open. For a pressure metal it is necessary to increase the copper content from 8 per cent, to 12 per cent. Should there be a leakage with 12 per cent copper, increase the copper to 14 per cent.

Wants Hard Bronze

We are using a mixture for a red brass which we have taken from page 157 of the Foundrymen's Handbook consisting of copper 88½ per cent, tin 5½ per cent zinc 3½ per cent lead 2½ per cent, which is good for most of the work we make. One of our customers wants a bronze that is hard so the chips will curl up like steel when it is cut in the lathe. He is getting such a material from another foundry. Will adding more tin to the mixture give these results?

On page 155 of the *Foundrymen's Handbook* there is a mixture that should be exactly what is desired. It is copper 90 per cent; tin 5 per cent; phosphor tin 5 per cent. The phosphor tin should contain 5 per cent of phosphorus. The mixture also can be made by using phosphor copper as follows: Copper, 88.25 per cent; phosphor copper, 1.75 per cent; tin 10 per cent.

Should the alloy be desired a little harder, increase the tin, adding 10.50 per cent of tin and taking the amount of tin added from the copper.

Castings Resist Pressure

We are making small aluminum castings having small cores set in and experience trouble with leakage. We use the following alloy: Aluminum, 78 per cent; copper, 2 per cent; zinc, 10 per cent; tin, 10 per cent. Can you inform us why the castings leak, under a pressure of 80 pounds per square inch?

The trouble lies in the use of an unsuitable alloy for resisting pressures. The metal has an open grain and is inferior to the cheaper alloy of aulminum, 82 per cent; copper, 3 per cent; zinc, 15 per cent. However, the alloy to use for castings to withstand pressures is one containing 88 per cent aluminum and 12 per cent copper.

Casting Bronze Tablets

Will you give me a good red brass mixture for name plates that will run sharp, as the plates are exceedingly thin, being nothing more than zinc etchings for patterns. I am now using a mixture of 64 parts copper, 4 parts tin, 1 part lead and 8 parts of yellow brass. This mixture does not seem to run well. Will yellow brass run better? Will you suggest a good mixture for tablets?

There is little difference in fluidity of red brass alloys, one will run about the same as another, and it is a question of getting the metal hot enough, pouring strongly, and making the mold to withstand the rushing of the metal and its high pouring temperature. The mixture being used will run as well as any red brass, and nothing will be gained by changing it.

For yellow brass use the following alloy: Copper, 60 per cent; zinc, 39.5 per cent; aluminum, 0.25 per cent; tin, 0.25 per cent. This alloy will run anything that can be molded in sand. Pour when it smokes a trifle after it is skimmed back. A mixture suitable for tablets is copper, 90 per cent; zinc, 7.5 per cent; tin, 2.5 per cent.

Making Aluminum Solder

We would like to obtain a formula for making aluminum solder, as we make patterns of aluminum which require soldering. At present we make a solder that works well, but unfortunately it is harder than the pattern, and as some of the soldered places are difficult to reach with files much time and effort is required to work them down to the level of the pattern surface.

The following alloys have been suggested by the bureau of standards and as the base is tin they should be softer than aluminum alloy. The first alloy has the highest elongation, its formula follows:

ALUMINUM SOLDER No. 1

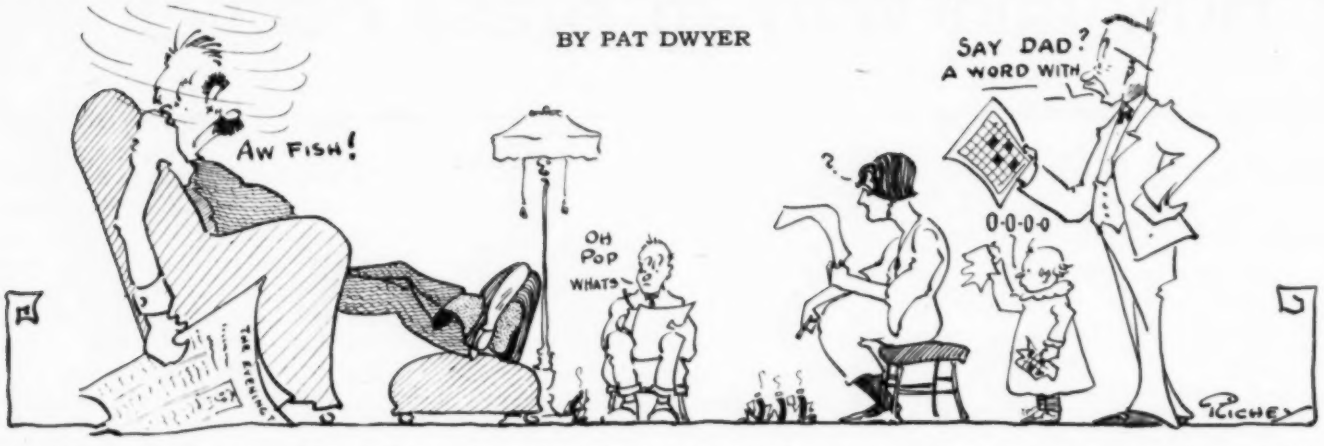
	Per cent
Tin	78
Zinc	8
Aluminum	9
Cadmium	5

ALUMINUM SOLDER No. 2

	Per cent
Tin	84
Zinc	9
Aluminum	5
Phosphor tin	2

Bill on How To Make a Slag Pot Mold

BY PAT DWYER



AFTER considering the subject judicially and calmly, impartially you might say and strictly on its merits—if it has any—I have arrived reluctantly at the conclusion that the man who invented that piffly indoor game known as crossword puzzles should be arrested. Having proceeded thus far, I am somewhat at a loss to determine just what form or degree of punishment should be meted out to him. However, as the one time famous Mrs. Glasgow was wont to remark shrewdly: "Before start ing to make your rabbit pie, first catch your rabbit." A rare old bird the same Mrs Glasgow. In our popular present day English she said a mouthful.

If my personal taste was consulted I would have him lined up against a wall, not at sunrise because I should not be there to see him, but at some convenient hour, say 3 o'clock on a fine sunny afternoon. For an appropriate finish I should like to see the outlines of an elaborate crossword puzzle tatooed on his quivering breast with a machine gun.

If the poor addle-pated creature had been content to play his little game by himself or in company with the other bats in the belfry, no reasonable objection could be filed against him, but when he persisted in broadcasting his checkerboard virus and inoculated practically the entire population from the innocent little cherub in the kindergarten to the doddering old relic in the chimney corner, I think he exceeded whatever rights were guaranteed him under a mild and beneficient constitution. He deliberately laid himself wide open to a severe vote of censure. Victims of this malignant disease throw every rule of decency and vestige of common sense in the discard and become private and public nuisances. They not only waste their own time, but exhaust the patience and practically worry the life out of all the people who come within the range of their pernicious influence. They are everlastingly and loudly crying for assistance to find words that will fit in a lot of silly squares. After the job is finished they are no wiser than they were before, even if they have discovered that the auk is a species of extinct bird or that a word of three letters means something they had for breakfast.

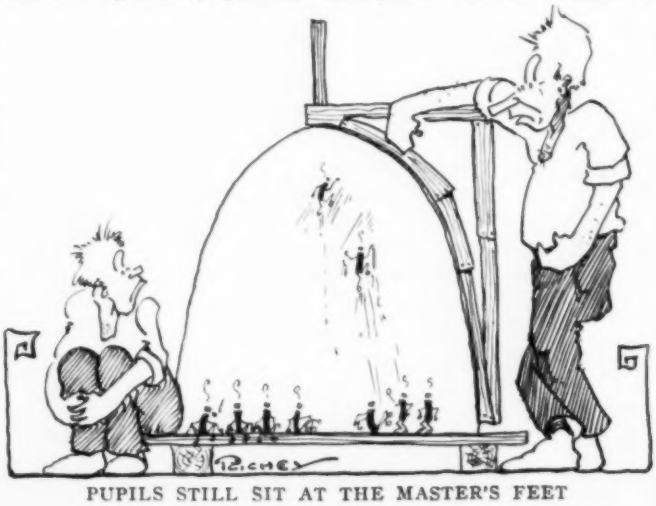
Why this sour and fishy outlook, says you? A fair question in sooth and one deserving a fair and civil answer.

At one time our little home was a quiet and peaceful haven to which I could return at night with the reasonable expectation of spending a few tranquil hours in repose or in any other manner my fancy dictated. The term tranquil is rather elastic like many other terms we use in a somewhat indefinite manner. Through a period of many years experience with a growing and exuberant family I have become accustomed to conditions that probably would drive those who have no children into a sanatorium, a home for the feeble minded or into a state of premature senility.

Insidious introduction of the crossword puzzle has worked havoc in this comparatively peaceful atmosphere and converted a haven of refuge into a bedlam where disjointed and obselete words fill the air thick as the autumn leaves on Vallambrosa. Where once a single copy of the evening paper sufficed for our modest requirements, we now find it necessary to procure half a dozen copies so that each member may lose no time.

Pitched battles constantly are in progress for the possession of the dictionary, Roget's *Thesaurus* and the encyclopedia. The winners of these bouts cause little trouble, but the losers give me no rest. With a confidence beautiful to behold, but which at times is highly embarrasing they refer questions to me concerning the meanings of words that in many cases I did not know even existed. Occasionally I win through by a fluke of fortune or a trick of memory that recalls an odd word I have heard at one time or another.

One night recently all the squares gradually were filled with the result that one of the vertical lines read *CHOUGH*. The thing was checked over half a dozen times but invariably the answer was the same and the family had almost made up its mind that the night's work was a total loss when I was appealed to as a final resort. Singularly enough I had heard the word at one time and remarked carelessly that I thought every person even those with only a rudimentary knowledge of the English language knew that a chough was a species of small crow with red legs, found in England. Funny is it not, what a small thing will recall circumstances that through time and distance apparently have passed entirely from one's mind. Mention of this word sent my mind racing back over a greater number of years than I care to consider and I saw myself a young molder in a strange foundry doubled up with an old Cornish molder sweeping



PUPILS STILL SIT AT THE MASTER'S FEET

up a loam mold for a slag pot. He was a skillful old lad, a gentle and kindly old soul and although his general knowledge outside of his chosen calling was exceedingly limited, he was a real gentleman.

He had not the faintest idea of how to figure the weight of a casting, the displacement of a core, the static pressure on a cope or the tensile strength of a holding-down bolt; but he could look at a ladle and gage to within 100 pounds the amount required to pour a 10-ton casting, he knew how to select weights to hold down a cope and he knew exactly how many bolts of a given size would hold the binder bars in place. He never had heard of geometry or algebra and did not even know the names of the instruments employed in drafting rooms, but he could grasp the salient features of a blueprint in its relation to a mold more readily than many men who make these same prints. Sometimes he consulted with the gaffer in his interpretation of the print, but usually he laid out and made his own plates and other rigging to suit himself. At that time I regarded the foreman of a foundry as a sort of omnipotent and supreme being, but age and experience brings wisdom of one kind and another, and looking back now I have a shrewd suspicion that the gaffer realized his limitations and was content to delegate the work and later assume all the credit for the beautiful castings turned out by the old Cornish master molder.

One of the advantages of manual labor, an advantage I am afraid I did not fully appreciate at the time, is the opportunity afforded to carry on a conversation on subjects totally unrelated to the work in course of erection. My partner had left his native land shortly after he had finished serving his time and had worked for varying periods of time in many parts of the world.

He made no pretense of having hobnobbed with the elect of these countries and in some instances only had a hazy idea of their geography or form of government, but he was nobody's fool and had a fund of interesting observations concerning local events and people in the shops and public houses where he had spent his time.

However, his favorite subject was his old home in Cornwall and before I finally drew my card and modestly slipped out of town on a convenient freight train, I was almost as familiar with the territory as he was himself. Among other things I heard the legend of the *chuff* in which the spirit of King Arthur is reincarnated, although it was many years later before I learned that the name of this red legged crow is spelled chough.

Many a time in fancy I accompanied my friend through western England and traveled along the granite spine of the peninsula of Cornwall, my interest infallibly aroused by the deserted tin mines scattered everywhere over the landscape. Each stretch of purple-heathered moor has its ruined engine house, with a chimney from which smoke long since had ceased to roll. Almost every eminence that rears itself against the skyline is crowned by a pile of gaunt, derelict masonry resembling nothing so much as an ancient feudal keep of the days of the Henrys and Richards.

SOME DAY ARTHUR WILL RETURN

For safety's sake many of the shafts have been choked artificially by blasting. However, some remain unguarded with the exception of a low stone ledge. Others have not even this protection. Their gaping mouths fringed with fern or bracken remain as cavernous memorials to an age when English tin supplied the demand of half the world.

Numbers of mines still are working near Cambourne and Redruth. The massive old time pumping beams wheezily rise and fall, sky and buildings are dull and depressing and the general effect is the same as that produced in more favored localities on a rainy dismal day in the fall of the year. Every second man on the street is a *cousin Jack*, a local term that has followed Cornish miners around the world. The district is a living picture of what all the mining tracts were when Victoria was a girl queen and competition from Perak and Selangor in far away Malay was unknown.

History of later years would seem to indicate that nature has taken sides against cousin Jack. Cornish ore must be won by hewing blocks of the living granite from a deposit that continually has grown harder since the days of Adam. The granite of Asia softened and permeated for ages by tropical ground waters, easily is cut by Chinese miners and the refined and finished product is shipped all over the world from the fortified British city of Singapore.

One of the most famous of all Cornish mines, the Ding Dong, stands on a lonely hillside a few miles from St. Ives. At intermittent intervals one hears a rumor that it will be reopened. Any person who climbs the gorse clad slope and rests his eye on the desolate engine house and the grass grown mounds that mark the place where the residue was dumped, will experience no difficulty in realizing that Ding Dong's day is over. The houses and the chimneys belong to another day and another, earlier, age. They occupy a legitimate position as landmarks with the nearby stone circle of the *Nine Maidens* and the *Lanyon Quoit* where 2000 years ago a savage chieftain was buried. Thousands of tons of tin are hidden beneath Ding Dong and many other old abandoned Cornish mines. In all probability it will remain there undisturbed until the time arrives for King Arthur to throw aside his disguise as a red billed chough, to which all good Cornishmen doff their hats, and comes again to his own land. That time lies in the indefinite future which mortal men call—*never*.

Last night Bill came in to smoke an evening pipe. He said he had been driven out of his own house by a flock of young puzzle artists. He was somewhat disconcerted to find that he had landed in a similar hot bed instead of the quiet little oasis in the desert he had expected to find. I told him of my experience on one of the preceding evenings and he silently shook me by the hand to express his sympathy.

"I think you are making a mistake" he said "in answering the questions the young people fire at you. It is like feeding a fire. I tried it for a while, but finally decided I was nothing but a goat. I told my outfit I knew nothing and the next person who asked me the meaning of a word would get knocked for a word in four letters used in football games. The children took me seriously, but tonight when the Missus asked me for a word of seven letters meaning a man's name I grabbed my hat and flew out through the word in four letters meaning a gap in the side of a house.

"Definitions in these puzzles are so delightfully indefinite. That bird's name might have been any one of a million. The question absolutely was without limit. For all I know to the contrary the lad who built the puzzle may have picked a synthetic name like the old colored lady who called her offspring Ferdilizer after his two parents Ferdinand and Eliza.

"Sometimes I wonder why people are satisfied to waste hours over problems that are of absolutely no benefit and

at the same time deliberately refuse to devote a minute to problems that intimately affect their own interest and advancement. Probably hundreds of young molders tonight are feverishly poring over a lot of black and white squares, cudgelling what they think is their brains to find a word of two letters that means existence. There are more ways of making that slag pot which engaged the attention of yourself and your old Cornish friend than there are meanings for a man's name and yet these same gallant young lads never try to learn them.

"The castings are made both in steel and iron and with the exception of the gating arrangement the molding methods are the same for both metals. Assuming that the casting is to be poured in steel, the *best* method depends on local conditions. Experienced molders could make a satisfactory casting with a pair of sweeps, a crab and a cover plate. By providing a full pattern, a corebox and an accurately fitting flask, a satisfactory casting could be turned out by a gang of laborers equipped with air rammers. The number of castings ordered usually is the deciding factor in determining the most suitable molding method to adopt. Several ingenious methods have been developed in plants where these castings are made continuously, but the rigging in each case is rather elaborate and the cost renders it entirely prohibitive if only one casting is required.

"Castings are made in some foundries with the bottom of the pot in the position it will occupy when in use. In other foundries the pot is cast in an inverted position. Both plans have their advantages and disadvantages. Following is a brief outline of several meth ods:

"1—The outside of the mold is swept in a pit with a single runner built of tiles or cores from a point near the bottom to the joint. The core is built on a plate, dried in that position, then rolled over and lowered into the mold in the pit. The advantage of this method is that no flasks are required. The disadvantage is that the core is an awkward job to roll over.

"2—The outside of the mold is swept as in the first plan. The core is swept over a number of cast-iron or steel segments erected on a circular plate and bolted together to form a shell conforming to the shape of the inside of the pot. Two and sometimes four of the segments are bolted to those adjoining through long slots. After the casting is poured, the top ring is removed. The crane then is attached to the two or four special segments and they are pulled to the limit of the slots. This treatment permits the casting to contract.

"3—The drag is swept in a pit. The core is rammed in sand in a manner that eliminates the necessity of rolling it over. Where only one casting is required the core may be rammed directly in the drag plus a thickness of sand corresponding to the thickness of metal. After the core is lifted out this thickness of sand is removed from the face of the drag. However, where many castings are ordered a permanent mold is swept in concrete to serve as a corebox. One arbor is placed on the bottom and rammed full of sand. Additional ring arbors are built on top and bolted to each other. The arbors are provided with chuck bars so that only about 6 inches of sand is rammed against the face of the corebox all the way up. The top of the core is covered by a large cope to which the arbor is fastened by long bolts. In one plant a number of segment cores take the place of the arbors and green sand. The cores are assembled inside a form, bolted together and then bolted to a cope that is lowered down on them. This method does away with the necessity of drying the core as a whole.

"4—In one or two places the pot is molded bottom side up and a large riser is placed on the top. This involves the use of an immense flask. A whole pattern is employed with the top loose. The inside of the pattern is rammed full of sand. Then the outside flask comprising the cheek and cope is rammed full of sand and taken away. The pattern is removed and after the mold is dried the two parts are reassembled and the casting is poured.

"Talking about crossword puzzles" said Bill with a grin "I heard of one the other day that is a little out of the ordinary. Levi brought a bowl of gold fish home and presented it to his son Abie with the remark: 'O A B C D goldfish!'

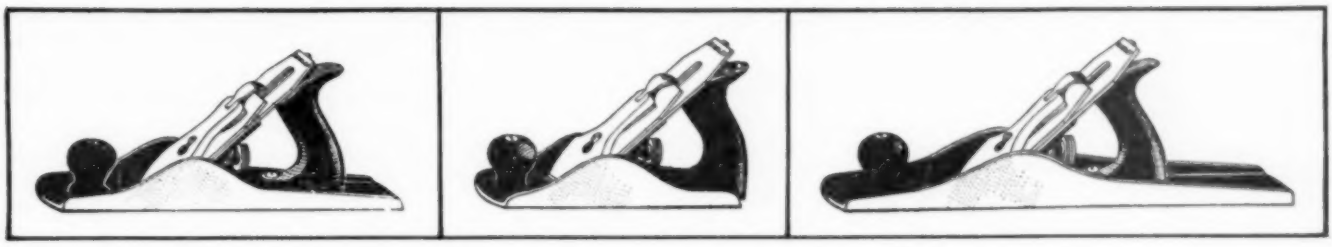
"Abie had the true inquiring mind and tested the occupants of the bowl by pouring a vial of acid over them. The result was disastrous. He accused his fond parent of trying to put something over on him. L says brave Abie 'M N O goldfish.'"

Issues Trade Booklet

The Austin Co., Cleveland, has issued a 36-page booklet entitled "From Plans to Pours" describing its complete foundry service. The booklet touches on nearly every phase of foundry practice. The company makes preliminary studies and plans for new plants or changes and additions to foundries now in operation. Numerous illustrations are shown covering foundry layouts, materials handled outside the foundry, materials handled inside the foundry, cupola charging systems, core making and handling, molding systems, etc. Ventilation and light for foundries is also considered. Concrete construction for scrap bins, sand storage, pattern storage, etc. is discussed with numerous illustrations.

George E. Karl, chief mechanical engineer for Wm. H. Nicholls Co., Brooklyn, and for many years identified with the foundry industry, has become associated with the American Radiator Co., 40 West Fortieth street, New York, as foundry equipment engineer.

CONFIRMING ONE OF MR. SHAKESPEARE'S WELL KNOWN PASSAGES "ALL THAT GLISTERS IS NOT GOLD"



Figs. 1, 2 and 3—The Chief Difference in the Jack, Smooth and Fore Planes is in the Length

Planes Smooth Patternmaker's Work

By Walter C. Ewalt

GEOMERY teaches that if a line is drawn connecting two points lying on a plane, all points on the line lie on the plane. If a straight edge is laid on a plane surface, all points on the edge of the straight edge touch the surface of the plane. No doubt the name *plane* for the instrument used by wood-workers was derived from the fact that the plane is used to make a true flat surface. The cutting part of the plane, which has been given various names such as cutter, bit, plane iron or blade, is a slightly altered form of chisel and pares the wood in the same manner, with the exception that the back of the chisel guides the cutting edge while the sole or bottom of the plane guides the cutting edge of the blade. Since the blade is held securely in the plane with suitable mechanism, it reduces the wood to a smooth, true and finished surface better than any other hand tool. Fig. 1 shows a jack plane while the smoothing and fore planes are shown in Figs. 2 and 3. The construction of the jack, smoothing and fore planes is the same, the planes differing only in length. The various parts of a block plane are shown in Fig. 12. The angle at which the blade is held in this type plane constitutes the principal difference between the block and jack plane.

Iron planes are much preferable to wood planes for various reasons, chief among which are the fact that the iron plane will keep its shape, the ease with which the depth of the blade may be adjusted by a screw arrangement and the possibility of keeping the edge of the blade parallel to the face of the plane by a lever controlling the sidewise and lateral movement. Another feature of the iron plane is the adjustable frog which permits the throat to be made narrow or wide. This adjustment is useful when planing cross grain or curly wood.

Four important factors must be considered in making a fine, smooth cut. The blade must be kept sharp, the plane iron cap must be placed close to the cutting edge of the blade, the throat or opening for the shaving must be made narrow and the blade must extend through the throat only a short distance so that a fine shaving will be made. It hardly is necessary to state that the blade must be sharp to do good work. A sharp blade not only produces a better finish on the wood, but it also makes it easier to push the plane along the wood. A dull blade tends to choke the throat.

The plane iron cap serves two purposes. Since the blades on the modern iron planes are of rather thin steel the blades would chatter if not held rigid. The adjustment of the cap either near or far from the cutting edge of the blade makes the surface smooth or rough. The reason for this difference in the quality of work produced may be noted in Figs. 5 and 6. In Fig. 5 it may be seen that the cap is near the edge of the blade, in which position it breaks the shaving off immediately. In Fig. 6 the cap is shown much further from the blade. In this case the shavings do not break off readily and the wood splits further in advance of the knife, thus making a rough surface. When the throat is narrow, that part of the sole directly in front of the throat is kept down firmly in front of the blade which prevents the fibers of the wood from splitting in advance of the blade.

The reason for the narrow throat may be seen in Figs. 7 and 8, as well as the need for the cap. The cap is especially needed when cutting against the grain, that is when the fibers of the wood are in the opposite direction to which the plane is being moved. If the planing is done in the direction of the grain, a single blade would be sufficient. Sometimes the wood is of such a nature that the ends must be reversed to make a smooth job and it may be necessary to plane at an angle of 45 degrees or more

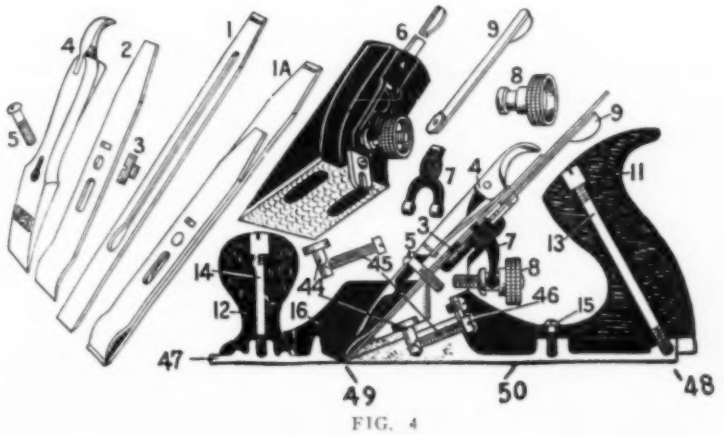


FIG. 4

JACK PLANE PARTS

1 Single Plane Iron
1A Double Plane Iron
2 Plane Iron Cap
3 Cap Screw
4 Lever Cap
5 Lever Cap Screw
6 Frog Complete
7 "Y" Adjusting Lever
8 Adjusting Nut
9 Lateral Adjusting Lever
11 Plane Handle
12 Plane Knob
13 Handle Bolt and Nut
14 Knob Bolt and Nut
15 Plane Handle Screw
16 Plane Bottom
44 Frog Pin
45 Frog Clamping Screw
46 Frog Adjusting Screw
47 Toe
48 Heel
49 Throat
50 Bottom or Sole

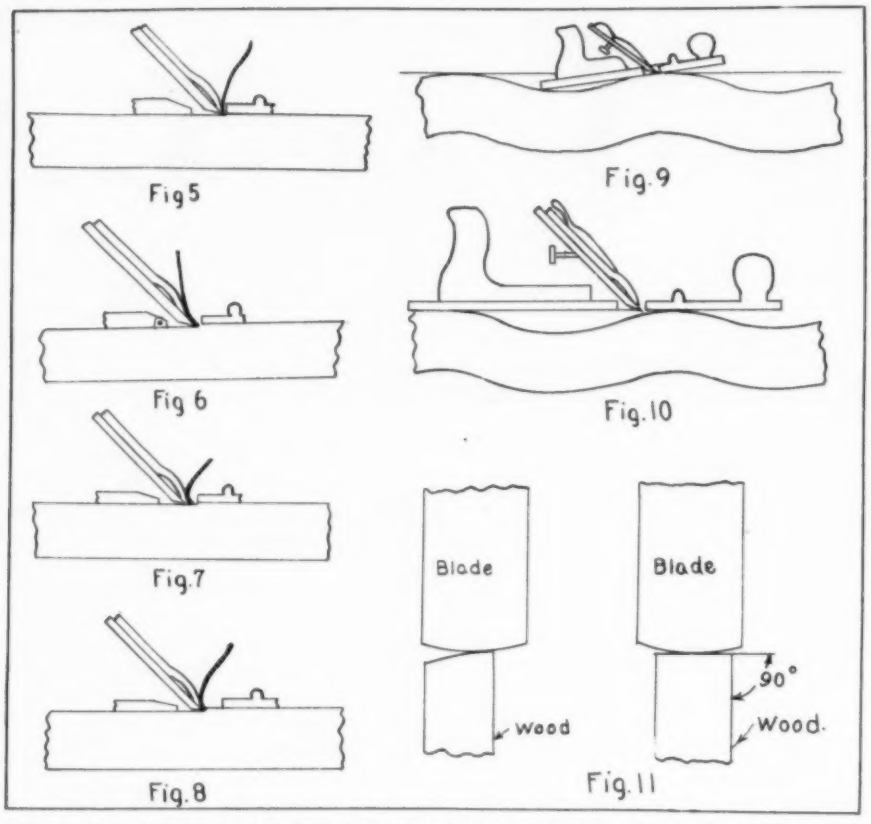


FIG. 5 AND 6—THE IRON CAP PLACED CLOSE TO THE EDGE OF THE BLADE PREVENTS A ROUGH SURFACE. FIG. 7 AND 8—THE WIDTH OF THE THROAT ALSO REGULATES THE SURFACE. FIGS. 9 AND 10—THE LONGER THE PLANES THE EASIER TO PRODUCE THE PLANE SURFACE. FIG. 11—SOME WORK IS MADE EASIER WITH THE CURVED BLADE

from the direction of the grain. Care must be taken to have the cap firm against the blade to prevent choking of the throat.

The length of the plane regulates the degree of accuracy which may be obtained when planing a board. This fact is shown clearly in Figs. 9 and 10. A somewhat analogous situation exists in the wheelbase of an automobile, it being much easier to ride when the base is long. The short plane follows the up and down curves as shown in Fig 9, while the long plane rests on the ridges as in Fig. 10. These ridges gradually are cut until a plane surface is obtained.

The jack plane is used for the first roughing cut, although many patternmakers also use it for the finishing operation. The blade of the jack plane is ground and sharpened slightly rounding or crowned, speed being obtained by rounding to a greater extent. A plane moves much easier if a little paraffin is rubbed on the sole. The fore plane is considerably longer than the jack plane and consequently the wood is straightened more easily with the former tool.

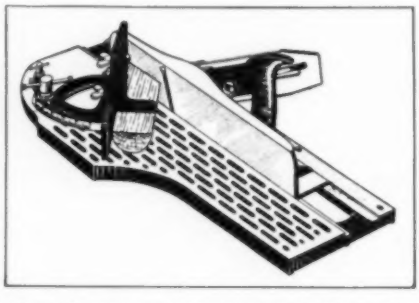


FIG. 13—THE SMOOTH BOARD AND PLANE IS USEFUL

Some patternmakers sharpen the blade of the fore plane perfectly straight tapering it slightly close to the end. Others grind the blade rounding, although the arc is considerably shorter than on a jack plane. The curved blade leaves slight hollow places in the wood which are sandpapered straight. The reason for making the blade rounding may be noted in Fig. 11. When making a board square on the edge, the rounding blade offers an opportunity to move the plane sideways so that the high side may be cut down more than the other parts with the portion of the blade which protrudes farthest. A movement of the lateral adjusting lever would be necessary if a straight plane were used to perform the operation mentioned.

The object of the short smooth plane is to smooth the work rather than to make it straight. However, it may be used for both purposes on short material. The blade is ground similar to a fore plane. The jack, fore and smooth plane are made with either smooth or corrugated bottoms. When purchasing any of these planes, the bottoms should be examined carefully to make sure that they are true planes, and that the sides are square with the bottoms.

Block planes are designed to be held in one hand to plane the ends of boards. Most of the blades are at an angle of 20 degrees, although some are made which are held at an angle of 12 degrees. The latter angle permits greater ease in working across the grain of the wood. Two hands may be used to hold the plane when the wood is held in a vise. The block planes range in length from 3½ to 7 inches, although in the low angle plane one type 14 inches long is made. This is designed for heavier work. The block plane has all of the advantages of the other types previously described, although the mechanism differs slightly. The plane has a lateral adjusting lever and the throat distance is governed by an eccentric plate to the right or left which opens or closes the throat. The plate is held in place by a screw. The screw also acts as a rest for the finger while using the plane. An-

(Concluded on Page 293)

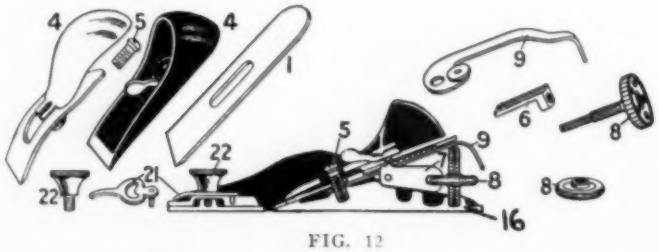


FIG. 12

BLOCK PLANE PARTS

1 Single Plane Iron
4 Lever Cap
5 Lever Cap Screw
6 Frog Complete
7 Adjusting Lever
8 Adjusting Nut
9 Lateral Adjusting Lever
16 Plane Bottom
21 Eccentric Plate
22 Finger Rest Knob

Milestones in Foundry Progress

As Recorded in the April Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago

A CUPOLA operated without blast was described by J. McCash in the April, 1895 issue. This was constructed in Allen's foundry, Glasgow, Scotland in the late thirties. A tuyere plate located well above the bed, provided openings around the shell, the top was a plate cover which turned on a trunnion permitting a charge to drop quickly to the bed, while a flue in the back connected to a chimney designed to give sufficient draft for melting the charge.

* * *

The Scots are a thrifty race!

* * *

J. W. Dearsley, Racine, Wis., told the Western Foundrymen's association how to melt borings by packing them in boxes or kegs.

* * *

A strong business revival was in progress and foundries ranging from stove shops to machine tool and engine plants were running full time. No. 2 foundry iron was selling at $9.75 to $10 cash, Pittsburgh. Rolling mill castings were selling at 1¼ to 4 cents a pound.

* * *

That it is a difficult task to introduce machines into the foundry seems to be the accepted opinion
* * * Kranks Korner

* * *

Many equipment salesmen today would second Krank's motion.

* * *

A gear molding machine, patented in 1875 by John Walker, Indianapolis, was described in detail with other later improved models.

* * *

At a meeting of the Plumbago club held in Cincinnati a friendly contest was entered upon by two members present as to the relative merits of the facings sold by their respective firms. The loser who paid for a box of cigars told of testing his product by marking his trade name on the flasks containing molds for sash weights. Although no facing was used in these molds, the mere presence of the name resulted in a high gloss, prefect face on the resulting castings.

* * *

The winning yarn must have been a tall one.

Faked Foundry Facts

Gangway!

THE Yale & Towne Mfg. Co. foundry at Stamford, Conn., was described and illustrated in the April, 1905 issue of THE FOUNDRY. This plant still is one of the leading production shops of the east.

* * *

N. W. Shed read a paper at a meeting of the Buffalo Foundrymen's association telling of the services of the chemist in foundry operation.

* * *

The process developed by C. W. Sherman, Bellevue, Pa., for making cast iron car wheels on a continuously operated, circular conveyor was described.

* * *

Ananias, given name not stated, was foreman of the Jerusalem and Jaffa Transport Co. foundry, located in one of the hilly industrial suburbs of the former city, according to report. The principal production job of this shop was cast brass chariot wheels. Ananias was telling a party of friends at his fireside one evening that he was casting these by pouring them in cylindrical molds, which he rolled down hill, causing the metal to form circular castings by centrifugal action. Whereupon, his wife, Sapphira, who was an interested listener interposed a violent word of doubt and discredit. This originated the expression, LIAR.

* * *

E. H. Mumford read a paper on foundry molding machines at a meeting of the Franklin institute, Philadelphia.

* * *

The plant of the Missouri Malleable Co., E. St. Louis, Ill., now a division of the National Malleable & Steel Co., Cleveland, was damaged by a severe fire.

* * *

In a question box session, conducted by the New England Foundrymen's association in Boston, a brass foundryman told of using salt in the sand. He said that he could produce good castings in high brass, using green sand, but not without salt.

* * *

Nowadays, foundrymen avoid sea beach sand in some cases, for fear of injurious effect of the salt evaporated in the sand.

BY STRANGE coincidence the leading story of the April, 1915 issue was on the same plant as that of the corresponding number of THE FOUNDRY of 10 years previous. However, the later and more extensive article was concerned with the brass foundry of Yale & Towne with details on the pattern storage features.

* * *

Each cycle of 10 years brings long strides in the methods and procedure of castings manufacture. From now until 1935 will see many changes.

* * *

J. F. Lincoln described the application of arc-welding to foundry work.

* * *

John Howe Hall, eminent metallurgist, who last year was awarded the Whiting medal by the American Foundrymen's association, gave some interesting suggestions on eliminating defects in steel castings.

* * *

The tentative program of the American Foundrymen's association, scheduled for Sept. 25, 1915 at Atlantic City was announced.

The Shakeout

A. O. BACKERT, Editor
DAN M. AVEY, Managing Editor
PAT DWYER, Engineering Editor
CHARLES VICKERS, Nonferrous Editor
GEORGE A. DRYSDALE, Metallurgical Editor
FRANK G. STEINEBACH, Associate Editor

¶ Reduce the Waste Line

ELIMINATION of waste is a paramount issue of the time. Large manufacturing companies, trade associations throughout the country and other business interests are interested in this vital issue. The ultimate aim is to reduce the needless waste of time, money, materials and human energy to a minimum, and thus produce a more healthy business atmosphere with more prosperous times.

WASTE was a war gift and became more or less of a habit during the postwar days of dizzy dalliance with prosperity. The effect of such waste now is experienced by the average citizen in high taxation which has a tendency to retard a healthy business growth.

According to Herbert Hoover, secretary of commerce, one of the greatest sources of waste is in faulty methods of distribution. Mr. Hoover in addressing the National Distribution conference held in Washington, Jan. 14 to 16, warned the 200 or more delegates present, representing trade associations, manufacturing and merchandizing activities, economists and government officials, that the elimination of waste is a task for the business men themselves to attack, through cooperative effort and not by legislative enactment. The secretary advised the delegates not to underestimate the formidable character of the tasks confronting all commercial enterprises.

NUMEROUS ways for eliminating waste were discussed. These included the adoption of a uniform system in recording the cost of distribution by manufacturers, wholesalers and retailers to be used as comparisons by all classes of distributors in studying their own cost; the principles upon which credit should be based and its relation to good and bad times; and the methods for arriving at the most economical rates of turnover and their effect upon expense. Increased sales effort is essential to end waste due to idle capital and equipment. Sales work which always precedes production, is imperative today.

¶ How Long Is a String

AN INTELLIGENT answer can be given only when a question is intelligible. Vague questions receive doubtful replies. To those who seek real information through the columns of THE FOUNDRY pertaining to patternmaking, molding, alloying of metals, melting, pouring, cleaning, etc., it is essential that such questions be asked in a simple intelligent manner describing as freely and concisely as possible individual working conditions. A good example of a vague question such as sometimes reaches this office is as follows:

Please send me a receipt for making semisteel and also one for making a good soft iron.

IT WOULD be impossible to answer such a querry in direct manner. An intelligent reply will depend solely upon the questioner's working conditions which are not given. Factors such as the furnace used in melting, condition of mold at time of pouring, size and nature of castings required are essential.

This is one of a number of such inquiries received during the year just passed. We have a creepy feeling that the recipient of the answer to such a question as given may regard us with pity and refer to us as *dumb-bells*. But, are we altogether at fault?

¶ Invade Casting Field

DESIGNERS of various commodities using metal parts continually are specifying pressed and forged products where formerly castings were designated. Long search is not necessary to discover examples of the production changes being made. Parts, such as industrial car wheels, gasoline pump bases, washing machine frames, textile machine parts, telephone boxes and parts, lighting fixtures, builders hardware, mail boxes, etc., which formerly were manufactured in the foundry now are built in the pressed metal shop.

THE two chief reasons claimed for this substitution for castings are lightness and reduction in cost. An example of the former may be had in the building of street cars where the demand for lighter rolling stock as a means of reducing power costs largely governs the design. Car builders are substituting pressed metal for castings wherever possible and practicable. Numerous other instances may be cited where the casting is being supplanted because of the weight factor. Reduced costs are said to develop because of the reduction in the amount of metal used, the elimination of certain machining operations, a speeding up of production and a saving in the investment for plant and equipment.

INVASION of the pressed metal manufacturer in the foundry field has had a suppressing influence on the demand for castings in many lines. In addition to devising methods of meeting this competition, foundrymen should benefit by the example set by the competitor and plan systematically to develop new uses for castings.

Trade Outlook in the Foundry Industry

BUSINESS and industry are filled with inconsistencies and paradoxes which cannot be checked, one against the other. The foundry industry, as is usual, presents no exception to the general rule. Where the average foundryman will state positively that business is quiet and that his orders are few, yet his state of operations may be well above the 50 per cent average and his shop may be showing a satisfactory profit. However, competition never was keener and the margin of profit necessarily is narrow. Another factor of interest is the hesitancy in placing orders far in advance of immediate needs. Practically all castings are sold to firms which take them on a hand-to-mouth basis.

Hesitant Buying

Reluctance to close orders in advance of immediate needs extends throughout the entire business world. The president of a large eastern railway states that where it formerly was possible to forecast trainload shipments for six weeks to two months in advance, at present the carriers do not know where each successive day's carloads will originate. However, freight shipments continue at an unprecedented high rate, and the railway business is flourishing. Following through, this same executive states that where his road previously had placed orders for 100 locomotives together, inquiries and orders now are placed in units of 20 or less. Similarly, in the automotive industry, where the middle of the month usually sees specifications placed for the following month, these now come to the foundries only a few days before the end of the month. Stocks are low in all lines and no effort is made to increase inventories. This condition, coupled with tendencies of lower prices in some lines, militate against advanced commitments. Caution rules in all buying.

Prices for Raw Materials for Foundry Use

CORRECTED TO MARCH 23

Iron		Scrap	
No. 2 foundry, Valley	$21.00 to 21.50	Heavy melting steel, Valley	$19.25 to 19.50
No. 2 southern, Birmingham	20.00 to 22.00	Heavy melting steel, Pitts.	18.50 to 19.00
No. 2 foundry, Chicago	24.00	Heavy melting steel, Chicago	16.00 to 16.50
No. 2 foundry, Philadelphia	24.26 to 24.76	Stove plate, Chicago	15.50 to 16.00
No. 2 foundry, Buffalo	22.00 to 22.50	No. 1 cast, Chicago	19.50 to 20.00
Basic, Valley	21.50	No. 1 cast, Philadelphia	18.50 to 19.00
Basic, Buffalo	21.50 to 22.00	No. 1 cast, Birmingham	17.00 to 17.50
Malleable, Chicago	24.00	No. 1 cast, Buffalo	17.00 to 17.50
Malleable, Buffalo	22.00 to 22.50	Car wheels, iron, Pittsburgh	19.00 to 19.50
Coke		Car wheels, iron, Chicago	16.50 to 17.00
Connellsville foundry, coke	$4.50 to 5.00	Railroad malleable, Chicago	18.75 to 19.25
Wise County foundry, coke	4.50 to 5.25	Agricultural, mal., Chicago	17.00 to 17.50
		Malleable, Buffalo	18.50 to 19.00

Coal Plot Thickens

Unrest and unsettled labor prospects in the coal fields are reflected sharply in production figures as prepared by the National Association of Purchasing Agents. During February bituminous coal production declined about 13,000,000 tons. Consumption in industry declined about 20 per cent during that period, but this in a measure was due to the short month with two national holidays occuring. Railway car loadings have maintained a high level during February and the early part of March. Southern and eastern railways continue to buy cars and large inquiries are expected by the close of the month. Unfilled orders for locomotives declined during February, according to the department of commerce. Scrap prices continue downward, and in many instances lower prices for pig iron are at hand. The Standard Sanitary Mfg. Co. has purchased its requirements for the second quarter. Stocks of iron in foundry yards are low, and no gain is registered in the tonnage held by the furnaces. French competition in cast iron pipe has made its appearance in the east and a lower price is quoted in domestic bids offered.

Auto Output Increases

Production of all classes of automobiles showed a gain in the United States and Canada during February, according to the department of commerce. The January total was 240,950 while February advanced to 287,019 passenger cars and trucks. This is considerable below the total for both the corresponding months last year, but it held to be a satisfactory increase in view of general conditions. Truck production, which includes fire apparatus and busses, is holding close to a steady level and is practically the same for February as for the same month last year. The output is expected to increase with the advance of the season and many confidently expect a total for 1925 higher than that registered in 1924. The Studebaker Corp. is operating at capacity, according to its president, and orders are about 25 per cent of the present schedule of operations. Bookings of steel castings decreased slightly in February, and the rate of operation stood at 61.3 per cent of capacity, according to the department of commerce. January showed 82.6 and December 95.8 per cent of capacity. The drop in railway specialties is the most marked, December showing bookings at 124 per cent, January 94.9 per cent and February 59.8 per cent of capacity. Slight increases have been noted through the three months noted in the miscellaneous steel castings bookings. Malleable foundry operations are slightly improved, the rate being given as 58.6 per cent for January, compared with 51.2 per cent for December, on a comparison of 131 identical plants. Unfilled orders for sanitary ware are increasing, as noted by the department of commerce. The total of unfilled orders for bathtubs stood at 108,572 in January and 115,085 in February. The total of small ware of all classes likewise shows an increase, while a loss is reported in orders for sinks and lavatories. Continued high prices for farm products hold out promise for the implement manufacturer. Increased production is reported in a number of midwestern implement shops.

Brass Shops Quiet

Little change is noted in the demand for miscellaneous brass and aluminum castings. New York prices on nonferrous metals, according to the *Daily Metal Trade* of March 24 follow: Casting copper, 13.87½c; electrolytic copper, 14.15c to 14.20c; Straits tin, 53.75c to 53.87½c; lead, 8.92½c to 8.95c; antimony, 14.00c; nickel, 38.00c; No. 12, remelt, aluminum, 22.50c to 23.00c. Zinc is 7.40c, E. St. Louis, Ill.

Comings and Goings of Foundrymen

JOHN H. ROBINSON, formerly foundry superintendent of the Evinrude Motor Co., Milwaukee, has accepted a position as foundry superintendent of the Clyde Iron Works, Duluth, Minn. Mr. Robinson was foreman of the foundry of Headford Bros., & Hitchins Foundry Co., Waterloo, Ia., from 1900 to 1918. He then became connected with Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich. in the capacity of foundry foreman. One year later he resigned to accept a position with the Waterloo Gas Engine Co., Waterloo, Ia., and two years later became foundry superintendent of the George B. Miller & Son Co., Waterloo, Ia. Mr. Robinson remained with this company for two years and then became foundry superintendent of the Evinrude Motor Co.

Walter Wood, R. D. Wood & Co., Philadelphia, has left for a European trip.

J. J. Murray has been appointed New York City representative for the Detroit Steel Casting Co., Detroit. Mr. Murray's offices are at 227 Fulton street.

F. A. Schneider has been elected president of the Gartland-Haswell-Rentschler Foundry Co., Dayton, O. Mr. Schneider has been general manager of the company for 4 years.

S. Horace Disston, vice president, Henry Disston & Sons, Tacony, Philadelphia, addressed the Philadelphia Foundrymen's association March 11, on the manufacture of steel saws, files, trowels and other tools.

Louis E. Clarke, for the past 5 years sales manager of the die castings and bearing department of the Hoyt Metal Co. St. Louis has been placed in charge of the Detroit branch of that company.

Fred Schuster has been appointed foundry superintendent of the Toledo Machine & Tool Co., Toledo, O. Mr. Schuster has been employed by that company as foundry foreman for the past four years.

W. A. Markwell has been appointed foundry superintendent of the Coulter & McKenzie Machine Co., Bridgeport, Conn. Mr. Markwell formerly was with the Farrell Foundry & Machine Co., Ansonia, Conn.

Charles Haydock, formerly engineer of the Pennsylvania Railroad Water Companies has become vice president and general manager of the Lansdale Foundry Co., Inc., Lansdale, Pa., maker of gray iron and semisteel castings.

Daniel Sharpe, manager, Foundry Plant & Machinery, Ltd., Glasgow, Scotland, is visiting the United States for the purpose of familiarizing himself with the latest improvements in American foundry equipment. Mr. Sharpe expects to remain in the United States about a month.

Edwin S. Carmen, secretary and chief engineer, Osborn Mfg. Co., Cleveland,

JOHN H. ROBINSON

discussed the mechanical conditioning of foundry sand and its effects upon casting quality at a meeting of the New England Foundrymen's association held at the Exchange Club, Boston, March 11.

George A. Bole, who presided at the recent refractory session of the American Ceramic society held in Columbus, O., is connected with the Ceramic experiment station, a department of the bureau of mines located at the Ohio State university, Columbus, O.

John T. Stoney president of the Stoney Foundry Engineering & Equipment Co., Cleveland, and vice president and general manager Ferro Machine & Foundry Co., Cleveland, has left the city for a 6 weeks visit to the Island of Jamaica. Mrs Stoney accompanied him.

F. J. Cook past president of the Institute of British Foundrymen has resigned his position of managing director of Rudge, Littley, Ltd., but still retains his seat on the directorate. Mr. Cook has associated himself with W. O'Keefe as sales director to the Adaptable Molding Machine Co., Birmingham, England.

Schuyler Merritt, Stamford, Conn., has been elected chairman of the board of directors Yale & Towne Mfg. Co., Stamford, suceeding the late Henry R. Towne. Gabriel S. Borne, Eastern, Pa. has been elected a director and Addison Boren, Stamford, was elected treasurer of the company to succeed J. Henry Towne who declined re-election.

Discuss Die Casting at Detroit Meeting

More than 75 per cent of the die mold production of the country is used in the automotive industry, according to an address by Marc Stern, Doehler Die Casting Co., at a meeting of the Society of Automotive Engineers held Thursday evening, March 19, in Detroit. The precision and speed with which small magneto parts, spark and throttle levers, brush holders, body hardware and miscellaneous articles can be produced in die castings, has been responsible for this condition.

Die casting is roughly divided into low pressure and high pressure casting. The former utilizes from a few ounces to 35 pounds, while the latter is classified by its requirement of from 50 to 1000 pounds pressure.

Die castings have been made successfully from tin, lead, zinc and aluminum base alloys and a few have been successfully made in brass. The tin base alloys containing about 90 per cent tin, fuse at 450 degrees and develop about 8000 pounds per square inch tensile strength. The lead base alloys have a higher melting point and practically the same tensile strength, while zinc alloyed with tin and copper or aluminum and tin melt at 780 degrees and will develop from 16,000 to 35,000 pounds per square inch tensile strength. The aluminum base alloys range from 18,000 to 21,000 pounds tensile.

In describing the merits and shortcomings of die casting, Mr. Stern outlined some necessary precautions. Under cuts, sharp corners and fine threads should be avoided. All engraving should be raised and a finish allowance for machining of

1/32-inch of tin, 3/64-inch for zinc and 1/16-inch for aluminum should be allowed. Die castings can be produced accurate to within 0.001-inch in tin and lead and from 0.002 to 0.004-inch accuracy in zinc and aluminum.

It is possible to make inserts of steel, brass or other metals in die castings. These inserts are not held by fusion bond but rather by shrinkage contact and by special lugs or projections provided on the inserts.

Dies used for these alloys vary. Zinc base alloys may be cast in medium carbon steel dies but aluminum requires high carbon and usually heat treated blocks. Dies are preheated and require about 400 degrees temperature for zinc with about 600 degrees for aluminum. Water cooling maintains an even temperature during continuous casting.

In the discussion which followed Mr. Stern's paper, J. W. Ostheimer of the Franco-American Wood Rim Co., Paris, described the production of aluminum steering wheel spiders in what is known as a Gothias mold. This process consists of placing a predetermined amount of molten metal in a die and forcing in a center core under pressure to give the internal section of the casting. The dies are made from plain gray iron, cost about $60 a piece and will produce upward of 100,000 castings. Other forms of pressure die casting and permanent mold casting in aluminum and iron were discussed.

Recommend Double Melting

Among the thirteen papers read and discussed at the annual general meeting of the Institute of Metals held in London at the Institution of Mechanical Engineers on March 11 and 12 was one on *A Method of Improving the Properties of Aluminum Alloy Castings* by S. L. Archbutt of the National Physical Laboratory. The experiments described in this paper and the results obtained from them indicate the possibility of a method for treating aluminum and certain of its alloys, to eliminate a considerable proportion of dissolved gas and thus reduce unsoundness, and pin holes. The suggested process applies especially to sand-castings and consists in allowing the molten alloy or metal to cool slowly to the solidification point in the crucible in the furnace. It is then remelted, carefully stirred, raised to the pouring temperature and pound. Ingotting the metal is not satisfactory. The ingots cool too quickly and are exposed too much to the furnace gases during remelting. In a later experiment, suggested by Dr. Rosenhain of the National Physical Laboratory, the passage of an inert gas such as nitrogen through the molten metal during slow cooling and solidification has been found to improve still further the soundness of resulting sand-cast bars.

Slightly anomalous results have been obtained in some cases and investigators have not decided to what extent the method may be applied to other alloys. Much further investigation is required. In this connection it is interesting to note that simultaneously and independently Professor C. A. Edwards, University College, Swansea, Wales and W. E. Prytherch, Swansea, working for the British Nonferrous Metals Research association on the effect of gases in copper have discovered a similar effect obtained where pure copper is allowed to solidify in the crucible in which it is melted.

In the discussion which followed, it was pointed out that in certain cases good metals in sheet form cannot be welded and it was suggested that an explanation could be given similar to that given with respect to pin-holding in aluminum alloys cast in sand. This also might explain the corrosive effects noticed on aluminum sheets. It was stated that most foundrymen would not find the proposed process practical and it was asked whether absolute solidification is necessary. Inquiry also was made as to the origin and character of the gas found in the cavities.

Dr. Rosenhain is inclined to the opinion that the gas enclosed in the cavities is hydrogen. He said that the outlined process is easy and practical and the cost is comparatively small. As to the risk of spoiling the metal in remelting, he said the metal should not be exposed unduly to the furnace gases. The speaker also suggested ingotting the metal in sand molds the shape of the remelting crucible. His experience indicated that putting the metal under reduced pressure would be a long process since he found gas still escaping from the cavities after a week. The process might be applicable to other alloys.

Dr. Denis Bunting presented a paper on *The Influence of Lead and Tin on the Brittle Ranges of Brass* which showed that the chief effect of lead is mechanical. The brittle range in itself is not affected but is masked owing to the embrittling effect at other temperatures of the lead which segregates. The effect of tin may be considered under two headings; tin in solution and tin in excess of the solubility limit. Tin in excess of the solubility limit produces extreme brittleness. The effect of tin in solution appears to be connected with an increase in crystal rigidity.

Planes Smooth Pattern-makers Work

(*Concluded from Page* 288)

other distinctive feature of this plane is the fact that the blade is inverted, that is the bevel is on the upper side. This is made necessary by the low angle at which the blade is held. The blade is single, no plane iron cap being provided.

Another useful tool for the pattern-maker is the shoot board and plane shown in Fig. 13. Although the disk grinder is being used in place of the shoot board and bench trimmers, nevertheless in certain shops the boards largely are used. The plane shown is made especially for the base and has the blade set on a skew, thus making a smooth, clean cut. The base has the necessary adjusting parts to hold the work at any angle between 45 and 90 degrees. The lateral adjusting level may be moved slightly to give the wood any draft desired.

Denies Coal Explosion Caused Fire

The recent fire at the plant of the Muncie Malleable Foundry Co., Muncie, Ind., was not caused by a coal dust explosion as reported in some sources, according to the Holbeck Engineering Co., Cleveland, manufacturer of the pulverized coal system installed at the plant. The Holbeck company states examination of the pipes leading into the coal plant disclosed the fact that there had been no fire in them.

Obituary

Richard Muse, aged 66, former superintendent of the Marshall Foundry Co., now out of existence, died recently at his home in Pittsburgh. Mr. Muse was connected with the foundry company 34 years, and retired 6 years ago.

George J. Blackham, aged 49, died recently in his home in Allison Park Heights, near Pittsburgh. He was born in Harmarville and was connected with the manufacture of cast iron enameled ware. Mr. Blackham was instrumental in starting a number of plants, including the Iron City Sanitary Mfg. Co. at Zelienople, Pa., the Wheeling Sanitary Mfg. Co., Wheeling, W. Va., the Conemaugh Iron Works at Blairsville, Pa., and the Richmond Radiator Enameled Ware Co. at Uniontown, where he was general manager for 12 years. Owing to ill health he was compelled to resign in 1919.

VALVE CONTROLLING FLOW IS MOTOR OPERATED

Controls Flow of Gas

A motor operated gas valve for controlling the flow of gas to the burners has been introduced by Dickson Industrial Equipment, Chicago. This regulator is applicable to core ovens and may be used with either gas or oil fired equipment. When actuated by a pyrometer regulator or thermostat, the burner causes a predetermined temperature to be maintained in the oven.

A small motor is arranged to operate a cam through a series of reducing gears. When controlled by a thermostat, the motor stops in position either to open or close the valve in the fuel lines. The motor is designed to operate on any standard lighting circuit. As may be noted in the accompanying illustration, the power unit, consisting of an electric motor, gears and cam, may be separated from the fuel valve, thus making the power unit interchangeable with the size or type of fuel valve required.

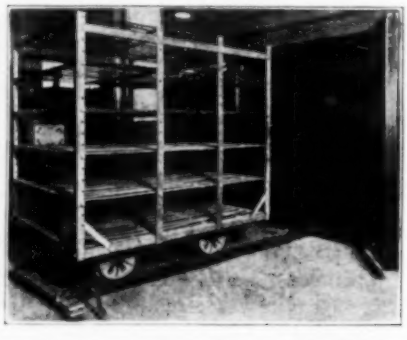
Air Compressor Driven by Synchronous Motor

A line of synchronous motors has been designed, which are especially adopted to a single straight line air compressor operation, and are used on a line of compressors manufactured by the Chicago Pneumatic Tool Co., New York. The motor is designed with the rotating element outside of the stator. The stator is mounted on a cradle support bolted to the compressor frame. This cradle support is bored concentric with the compressor bearing to give perfect alignment of the stator and uniform air gap when assembled. The rotor presents the appearance of an ordinary flywheel, with the face crowned for driving an exciter or other auxiliary while the poles are on the inner face of the rim.

The air gap in this motor is small, the problem of maintaining a uniform gap being solved by designing the stator so that the magnetic pull is upward, thus relieving the bearings of excessive downward pressure. The main bearings of the compressor are fitted with die cast bushings which may be replaced quickly. The line of air compressors now built by the Chicago Pneumatic Tool Co., and using this type of motor, includes sizes ranging from 139 to 1000 cubic feet displacement for 100 pounds discharge pressure up to 125 pounds.

Install Electric Oven on Repair Ship

The U. S. S. Medusa, the first naval vessel to be designed and built as a repair ship, is using electric heat for drying molds and baking cores. The ship which has a displacement of 10,000 tons, has equipment for making castings for almost any repair job on the warships,



MOLD DRYING OVEN IS EQUIPPED WITH ELECTRIC HEATERS

the exception being the main propelling engine castings.

The electric oven for baking cores, built by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is 7 feet x 7 feet 10 inches x 7 feet 6 inches. Double doors are provided. A track on rails is used for handling large cores, while shelves in the upper part of the oven take care of small cores. Five 2.5 kilowatt oven heaters are mounted on each side of the oven. A blower driven by a 1/6 horsepower motor is mounted on top of the oven to exhaust fumes and gases from the oven. The unit is equipped with graphic recording automatic temperature control apparatus. The mold drying oven is similar to the core oven, the only difference being that the stationary shelves are omitted. The handling truck completely fills the oven.

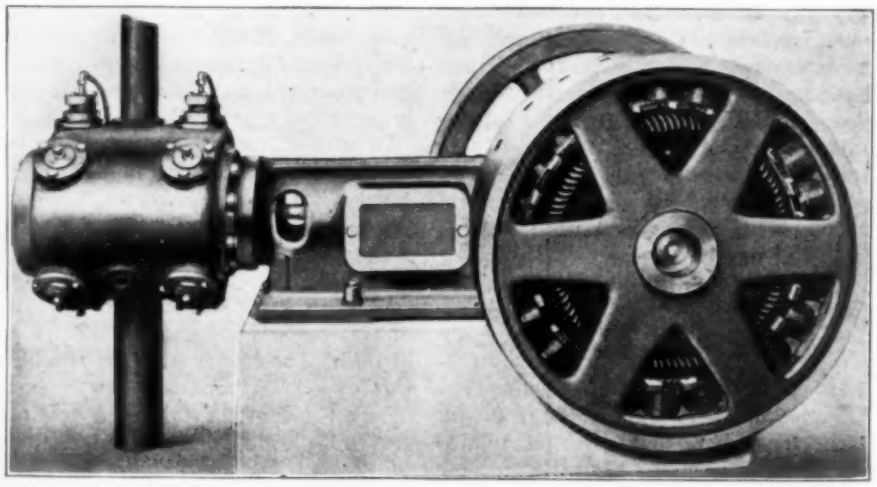
Foundrymen Entertain

Through the courtesy of director Clifford G. Connelley, Carnegie Institute of Technology, who is also a member of the board of directors of the American Foundrymen's association, the Pittsburgh Foundrymen's association entertained the ladies at the institute on the evening of March 16. Dinner was served in the men's cafeteria. Those attending the banquet were entertained by a concert by the department of music under the direction of J. Vic O'Brien, head of the division of arts.

Discusses Steel Castings

A joint meeting of the Quad-City Foundrymen's association, Tri-City chapter American Society for Steel Treating, and Tri-Cities section American Society of Mechanical Engineers was held at the Le Claire hotel, Davenport, Monday, March 16. R. A. Bull, research director, Electric Steel Founders Research group, was the speaker for the occasion. His subject "Steel Castings" proved of great interest to the members of all three groups.

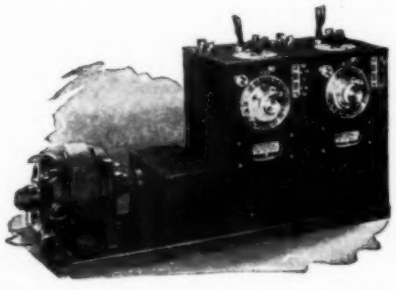
According to the department of commerce unfilled steel orders on Feb. 28, represented an increase of 247,448 tons over the previous month's figure and 371,870 tons over a year ago.



THE COMPRESSOR IS DRIVEN BY A MOTOR HAVING THE ROTATING ELEMENT OUTSIDE OF THE STATOR

Temperature Control Is Built in Units

An automatic temperature control built in units recently has been placed on the market by Wilson-Maeulen Co., Inc., New York. Each unit is built to operate one control and from one to six units may be driven from the same motor and gear system. The control is actuated by a thermocouple unit or by a thermocouple circuit. Either base metal or platinum-rhodium thermocouples may be used as conditions require. A standard ¼-horse-



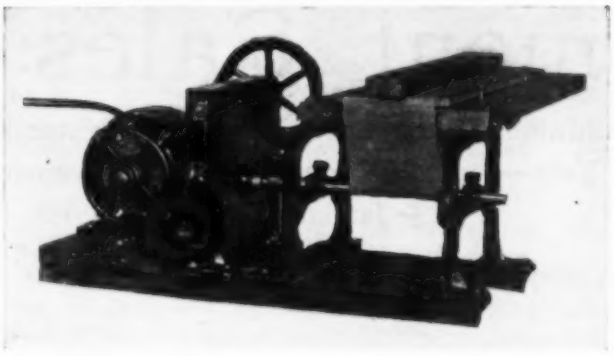
THE STANDARD CYCLE OF OPERATION IS 10 SECONDS

power motor, is used. The reducing gear is a double worm and wheel reduction running in an oil bath. The motor drives the control unit through a detachable link fitting into the slotted ends of the shaft projecting from the control unit. The shaft projects through the unit and is slotted on each end thus providing for the attachment of other units.

The standard cycle of operation is 10 seconds, but a cycle up to 20 seconds may be used. The machine is designed so that no auxiliary circuit passes through the pointer and the pointer does not come in contact with any part carrying an auxiliary or outside voltage. The control unit and the reduction gear are housed in a cast aluminum box.

Introduces Sand Tester

The Reynolds Electric Co., Chicago, has introduced a motor driven machine for testing sand mechanically. The apparatus consists of a motor, reducing gears and a shaft which is connected to the driving mechanism by a slot similar to that of a camera reel. It also includes a wooden platform on which the core plate is placed, this platform having four pegs to support the plate. The sand to be tested is made into a test bar on a waxed piece of paper and placed on top of the plate, one end of the paper being made to hang over for some distance. The plate then is placed on the platform and the overhanging piece of paper is inserted in the

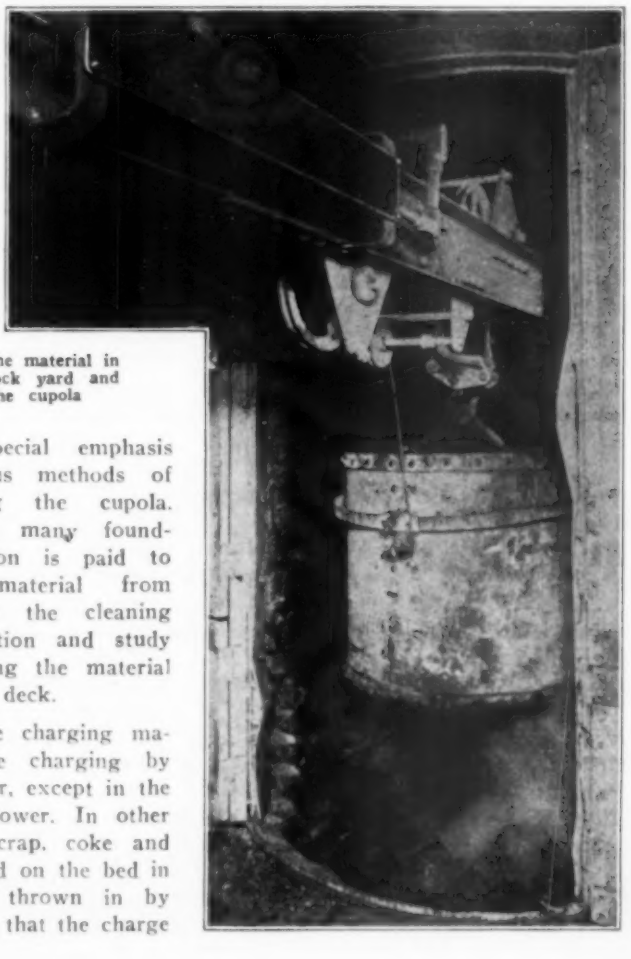


THE CORE IS PULLED OVER THE EDGE OF THE PLATFORM

slot on the shaft and the motor started. As the paper winds up the test bar of sand is pulled forward at a slow rate until the overhanging end of the sample breaks off. The breakoffs are caught and weighed, the weight of the sand being in proportion to its cohesive properties. The shaft is provided with a special knurled coupling by which it may be cut and the paper removed.

Crane Charges Cupola Mechanically

In a recent address at a meeting at the Philadelphia Foundrymens' association, George L. Drake, Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. discussed the development that has been made in the use of electric cranes, hoists and allied equipment in the foundry industry. He described various types of equipment from the ½-ton floor operated hoist to the large overhead



The charger carries the material in buckets from the stock yard and desposits it in the cupola

traveling cranes. Special emphasis was given to various methods of mechanically charging the cupola. He stated that in many foundries particular attention is paid to the handling of material from the cupola spout to the cleaning room, but little attention and study is given to transporting the material from the stock yard to deck.

He believes that the charging machine should duplicate charging by hand in every particular, except in the requirement of man power. In other words the pig iron scrap, coke and limestone should be laid on the bed in the same way as if thrown in by hand. This presupposes that the charge should be laid by hand on the charging machine in the yard, the charge being placed in the position desired in the furnace without change. Mr. Drake described the cupola charger made by the company with which he is associated. This charger is a cage operated electric monorail hoist which travels on suitable trackage, conveying charges from the stockyard direct to the cupola. Two types of charging buckets are made by the company, namely the bottom dump bucket and the umbrella type bucket. The bottom drop bucket allows a straight drop of the material. The umbrella type bucket, used principally for charging pig iron and scrap spreads the material flat around the rim of the cupola. An electric magnet may be attached to the charger to handle pig iron and scrap. The charger is shown in the accompanying illustration.

The Binney Castings Co., 121 Field avenue, Toledo, O., has been established to make brass bronze and aluminum castings by sand or permanent mold process. Norman I. Terille is manager.

Equipment Sales Increase

Manufacturers Making Headway Against Sales Resistance Experienced Since First of the Year—March Business Shows Improvement Over February —January Exports Heavier

THE tone of the foundry equipment market has improved steadily during the past two weeks. While the feeling of uncertainty, which seemingly has caused foundrymen to hold off buying for several months, still continues to be felt, manufacturers of equipment are finding slightly less resistance to sales efforts. Greater interest is being taken in equipment for replacement and expansion purposes than for some time past, inquiries being introduced at a high rate.

The first quarter was decidedly poor from the standpoint of equipment sales. After the flurry in December, sales of equipment took a sudden drop about the first of the year. However, a slow return to better business has been noted, the volume in February exceeding that in January, and March being the best month thus far this year. Manufacturers feel that this increase will continue, and that the next three months will see some substantial business closed.

Exports of foundry and molding equipment increased in January, the value of exports being $51,246 as compared with $38,845 in December. The value of exports for the seven months ended January was $382,169.

Inquiries Point to Better Business

THE foundry equipment industry in the Pittsburgh district showed increased business in March, although sellers still are inclined to complain about the slowness with which foundrymen generally are placing orders. It is expected that while buying throughout the second quarter will not partake of boom characteristics, a steady and healthful selling rate will be maintained. Several fairly attractive cupola orders recently have been taken by the Whiting Corp., Harvey, Ill., including a special cupola for the Standard Sanitary Mfg. Co., Pittsburgh; a special cupola complete with blower, elevator, etc., for the Ridge Cast Products Co., Mineral Ridge, O., and one for the Athens Foundry Co., Athens, Pa. The Whiting Corp. also disposed of a 10-ton ladle to the Lewis Foundry & Machine Co., Pittsburgh, and a helical worm-geared ladle to the Euclid Foundry Co., Euclid, O. One order for 15 tumbling barrels, various sizes, was received from the Crane Co., Chicago, for its new foundry, and the Mt. Vernon Car & Mfg. Co., Mt. Vernon, Ill., bought core oven equipment. The Andes Copper Mining Co., New York, purchased a complete outfit for a small foundry to be boxed for export to South America, including a cupola, etc. The J. S. McCormick Co., Pittsburgh, has sold two buggy ladles and several smaller hand and bull ladles to foundries in North Carolina. The company also sold a large motor-driven sand sifter to the Pittsburgh Gray Iron Foundry, Inc., Pittsburgh. Included among recent purchasers of cupola charging cans from the McCormick company have been the Page Boiler Co., Meadville, Pa., and the Chrisman Foundry Co., Morgantown, W. Va. Recent purchasers of air vibrators include such representative foundries as the Fort Pitt Steel Castings Co., McKees Rocks, Pa., the Verona Steel Casting Co., Pittsburgh, the Pressed Steel Car Co., Pittsburgh, and other nearby users. Numerous inquiries for molding machines are pending, some hesitancy about ordering being encountered by manufacturers such as the Herman Pneumatic Machine Co., Zelienople, Pa. However, the plant is operating full time on orders received, and making up machines for which verbal orders have been issued but on which the confirming orders have not come through. Actual orders coming to hand recently include one for two machines from the American Radiator Co., Buffalo, and the following for one each: Eddy Valve Co., Waterford, N. Y.; Michigan Valve & Foundry Co., Detroit; Standard Cast Iron Pipe & Foundry Co., Atlanta, Ga.; Farrell Foundry & Machine Co., Ansonia, Conn.; and the Staten Island Shipbuilding Co., Staten Island, New York. The Reading Foundry & Supply Co., Reading, Pa., is installing a comprehensive overhead trolley system in its plant, for the convenient transportation of materials and products. Some equipment is expected to be bought soon by the Stevenson Foundry Co., Wellsville, O., for a new addition. The Reliance Mfg. Co., Morristown, N. Y., contemplates the purchase of a complete line of foundry equipment for a new plant; D. W. Pelton is in charge of purchases. The Buckeye Steel Castings Co., Columbus, O., has placed a contract with the Chapman-Stein Furnace Co., Mt. Vernon, O., for an additional normalizing furnace. The new furnace will have a capacity of 14 heats of 10 tons each per 24-hour day. Crane orders are few and far between. The Elliott Co., Jeannette, Pa., bought a 5-ton electric overhead crane from the Northern Engineering Works, Detroit and the Pressed Steel Car Co., Pittsburgh, recently ordered a 15-ton crane from the Chesapeake Iron Works, Batlimore. A used crane was purchased by the Vulcan Mold & Foundry Co., Latrobe, Pa., and it probably will purchase a second one on opportunity.

Cleveland Inquiries Better

LITTLE change is noted in the foundry equipment market during the last two weeks. While a few manufacturers have sufficient orders to operate plants at a high rate, many have not secured the volume of business anticipated earlier in the year. Inquiries for foundry equipment are being brought out at a good rate and much interest is being shown in various lines. However, the same resistance to closing orders, which was noted some time ago, continues to hold the market. Nevertheless, men of the trade feel that active buying is not far away. The Wilson Foundry & Machine Co., Pontiac, Mich., has purchased a large sand mixing machine from the Standard Sand & Machine Co., Cleveland. The Bucyrus Co., South Milwaukee, Wis., has ordered oven equipment from the F. A. Coleman Co., Cleveland, including a large car type mold oven, three rack type ovens and four large car type ovens. The Ulrich Foundry Co., Erie, Pa.; the Weil-McLean Co., Michigan City, Ind.; the Michigan Malleable Iron Co., Detroit; the General Electric Co., West Lynn, Mass.; the Newell Sander Plow Co., Chattanooga, Tenn.; and the

Albany Malleable Iron Co., Voorheesville, N. Y., have purchased tumbling mill equipment from the W. W. Sly Mfg. Co., Cleveland, while the American Radiator Co., Buffalo, and the Columbia Sanitary Mfg. Co., Louisville, Ky., have closed on sand blast equipment with the same company. The Fox Furnace Co., Elyria, O., and the Etna Machine Co., Toledo, have purchased sand-blast equipment and the National Carbon Co., Cleveland, has secured sand-blast and dust arrester equipment from the Pangborn Corp., Hagerstown, Md. The American Cast Iron Pipe Co., Birmingham, and the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich., have purchased core knockout equipment while the Modern Foundry Co., Cincinnati; the American Steel Foundries, Granite City, Ill.; the Griffin Wheel Co., Detroit; the Westinghouse Air Brake Co, Wilmerding, Pa.; the American Radiator Co., Buffalo; the Standard Foundry Co., Racine, Wis.; the Cleveland Co-Operative Stove Co., Cleveland, and the New York Air Brake Co., Watertown, N. Y. have purchased shakeout and vibrator equipment from the Stony Foundry Engineering & Equipment Co., Cleveland. The Mayor Fuel Saving Furnace Co., Cleveland, has completed the installation of three rack type core ovens and furnaces at the plant of the West Steel Casting Co., Cleveland.

Improvement in New England

THE equipment market throughout New England has taken a decided turn for the better during the past two weeks. New England foundry activity continues at about the same rate, but buying of equipment has been postponed so long that many users now are forced into the market Inquiry covers four sizable cranes, as many electric furnaces and a long list of miscellaneous items including molding machines. Recent sales included a sand separator to the Guerney Heater Co., Framingham, Mass., a separator to the H. & B. American Machine Co., Pawtucket, R. I., and a separator to the Kellogg Co., Jersey City, N. J., by the Royer Foundry & Machine Co., Wilkes-Barre, Pa. The Blake & Knowles Machine Co, Cambridge, Mass., has purchased a sand mixer from the National Engineering Co., Chicago. Scattered foundries in Massachusetts and Connecticut have placed orders for 20 to 30 molding machines. The Waterbury Mfg. Co., Waterbury, Conn., has purchased dust arrester equipment and the New Haven Malleable Iron Co., New Haven, Conn., sand-blast equipment from the Pangborn Corp., Hagerstown, Md.

Eastern Buying Lags

WHILE there is perhaps a little more inquiry, actual buying of foundry equipment continues to lag in the East. It is doubtful, according to some sellers, if business in March was much heavier than in the preceding month. New projects are lacking, and with little change in foundry operations, the situation generally is not conducive to increased buying. Jobbing foundries are operating perhaps on an average of 50 per cent. Equipment sellers state that when the foundries are buying supplies practically no interest is shown in equipment. Of course, when supplies are being bought heavily, indicating greatly increased operations, equipment sellers feel they have cause for encouragement. One disappointment in the supply field has been in the movement of sand. With March normally a good month because of the more open weather, a material improvement should have developed. Particularly is this true, it is stated, because many of the foundrymen in this district were known to have bought short last fall. Of interest to the trade is the announcement that the city of New York will open bids May 8 on the proposed Narrows tunnel, between Brooklyn and Staten Island, involving 98,000 tons of cast iron segments. A recent equipment buyer is the H. P. Smith Mfg. Co., East Orange, N. J., which in addition to orders previously reported, has closed on a 72-inch cupola. The United States Cast Iron Pipe & Foundry Co., Burlington, N. J., is in the market for another lot of cranes, eight 5-ton cranes in all. The North Jersey Foundry Co., Paterson, N. J. contemplates alterations costing $25,000 to its foundry near Singac, N. J. The American Car & Foundry Co., Berwick, Pa., will require some new equipment for a wheel foundry and pattern shop, recently badly damaged by fire. The General Electric Co., West Lynn, Mass. and the Thermal Syndicate, Ltd., Neptune Works, Wallsend-on-Tyne, London, each have purchased a 35-kilovolt ampere high frequency converter with small high frequency induction furnaces from the Ajax Electrothermic Corp., Trenton, N. J.

Chicago Dealers Encouraged

FOUNDRY equipment manufacturers in the Chicago district are much encouraged by a decided increase in inquiries. Most of this inquiry appears to be live. Sales naturally have not yet caught step with inquiry. The National Engineering Co., Chicago, has placed its sandmixers in the foundries of the Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.; Fairbanks, Morse & Co., Three Rivers, Mich.; Worthington Pump & Machinery Corp., East Cambridge, Mass., and the Standard Cast Iron Pipe & Foundry Co., Atlanta, Ga. The Beardsley & Piper Co., Chicago, have sold a stationary sand throwing machine to the Columbia Sanitary Mfg. Co., Louisville, Ky., and a portable sand throwing machine to Melters, Ltd., Sidney, Australia. The Holt Mfg. Co., Peoria, Ill., has purchased sand-blast and dust arrester equipment from the Pangborn Corp., Hagerstown, Md.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Enterprise Foundry Co., Tacoma, Wash., has been incorporated with $10,000 capital stock.

Plans are being made by A. B. Chance Jr., and associates for a 1-story foundry to cost about $25,000 at Centralia, Mo.

Stevenson Foundry Co., Wellsville, O., T. A. Hibbens, president, will build a 1-story addition to its foundry.

Wolverine Brass Mfg. Co., Grand Rapids, Mich., will build a boiler house bids being asked on structural steel by W. A. Adams.

S. E. Fry, Kalamazoo, Mich., is having plans prepared for a new plant to house his gray iron foundry.

General Electric Co., Erie, Pa., C. G. Wright, superintendent, will build a 1-story woodworking shop 101 x 220 feet.

Sunset Sanitary Mfg. Co., 911 East Sixty-second street, Los Angeles, will build a foundry 34 x 107 feet, as a plant addition.

The Binney Castings Co., 121 Field avenue, Toledo, has been established to make brass, bronze and aluminum castings.

Shulte Brass Mfg. Co., Norwood, O., is taking bids for a new plant 50 x 300 which will include a brass foundry.

Muncie Malleable Foundry Co., Muncie, Ind., will rebuild a portion of its plant recently destroyed by fire.

Athens Plow Works, Athens, Tenn., is having plans made for additional buildings and will install especially constructed machinery.

Morton Machine Works, Columbus, Ga., has been incorporated with $100,000 capital to operate a foundry and machine shop.

Crescent Stove & Mfg. Co., Lehighton, Pa.,

will rebuild a portion of its plant damaged by fire and will buy new equipment.

North Jersey Foundry Co., 136 Grabd street. Paterson, N. J., will remodel a car barn at Singac, N. J., into a foundry, 1-story, 50 x 70 feet.

Athens Stove Works, Athens, Tenn., J. D. Farrell, secretary, will build two additions, 80 x 200 feet and 92 x 200 feet, for offices and pattern rooms.

H. Sofransey Co., Allentown, Pa., plans remodeling a blast furnace recently purchased and equipping a sash weight and soil pipe foundry.

McClintic-Marshall Construction Co., Pittsburgh, is reported to have purchased the plant of Bartlett-Hayward Co., Scott and McHenery streets.

Wichita Falls Foundry & Machine Co., Wichita Falls, Tex., has been incorporated with a capital of $75,000 by J. V. Christensen and O. B. Cecil.

American Car & Foundry will rebuild the portion of its plant including the wheel foundry and pattern department damaged by fire Feb. 27.

Gartland-Haswell-Rentschler Foundry Co., Dayton, O., will enlarge its factory and install a large amount of new equipment, doubling the capacity of the plant.

Contract has been let for the foundry which recently was announced as being planned by the Berryhill Malleable Iron Co., 1215 Powell street, Evansville, Ind.

Burns Foundry Co., Battle Creek, Mich., Fred Flanders, president, is seeking a site for a larger foundry to meet increasing business demands.

Reading Foundry & Supply Co., Reading, Pa., is installing a comprehensive overhead trolley system in its plant, for the convenient transportation of materials and products.

J. M. Carpenter & Co., Wainwright building, St. Louis, has let a contract to J. J. Bassett, 926 N. Twenty-sixth street, for alterations to a foundry building.

Greenville Steel & Foundry Co., Greenville, S. C. is having plans drawn for increasing both plant and facilities. The plant specializes in cast mill machine parts.

Acme Stamping & Brass Works, Inc., Zeeland, Mich., has been organized recently by John Glupker and A. Elenbaas for the production of aluminum castings.

Chattanooga Implement & Mfg. Co., Chattanooga, Tenn., manufacturer of agricultural implements, will build an addition 80 x 350 feet, for which new equipment will be needed.

Rex Foundry Co., Perth Amboy, N. J., has been incorporated with $125,000 capital by Peter A. Johansen, Frank Windman, Thomas G. W. Fine. Emil Stremlau, Perth Amboy, is attorney.

Martin Metal Foundries Co., Newark, N. J., has been incorporated with $300,000 capital stock by J. F. Cleaveland, E. F. Kavary and E. W. Rihl. J. W. Robertson Corp., New York, is attorney.

Dudley Tire Mould & Mfg. Co., 561 Pacific boulevard, Los Angeles, will build a plant on Slauson avenue to double its capacity. Foundry and machine shop equipment will be increased.

Ward Heater Co., Los Angeles, is having plans made for a $250,000 brick plant at San Antonio, Tex., which will include a foundry, plating and assembly. Work wlh not be started before July.

Southern Car & Foundry Co., Jackson, Tenn., has bought the plant of the Southern Motors Co., Houston, Tex., and plans a 1-story foundry addition and machine shop which will need equipment.

Harnischfeger Corp., Milwaukee, crane builder, will build a 1-story addition 60 x 88 feet to the core room of its electric steel foundry, recently acquired from the former Hercules Steel Castings Co. Other improvements will be made.

Die Cast Art Bronze Corp., Jamestown, N. Y., has been incorporated with 1500 shares at $100 each and 5000 common no par value by M. Pike, R. L. Johnson and G. A. Herrick. Service Co., Albany, N. Y., is attorney.

Denmark Machine & Foundry Co., Denmark, S. C., has bought the plant and equipment of the T. J. Price Foundry & Machine Co., and additional equipment will be provided for the manufacturer of sawmill machinery and for general machine work. T. E. King is general manager.

August Lamp and D. C. Carroll have opened a jobbing pattern shop under the firm name of Galesburg Pattern Works situated in a part of the plant operated by the Acme Foundry & Machine Co., Galesburg, Ill. Mr. Lamp will supervise the wood department and Mr. Carroll will have charge of the metal department.

George R. Meneely & Sons, Inc., brass foundry, Watervliet, N. Y., filed a schedule in bankruptcy at Utica, N. Y., March 18, with liabilities of $163,805 and assets of $142,414. The Meneely firm has been in business for years and long has been one of the best-known manufacturers of bells in the United States.

New Trade Publications

CEMENT—A high temperature cement is described in a booklet issued by the Botfield Refractories Co., Philadelphia.

HOISTS—Roeper Crane & Hoist Works, Inc., Reading, Pa., describes one type of its electric hoist in a leaflet well illustrated and containing data to aid buyers and users.

CO_2 RECORDER—Uehling Instrument Co., Paterson, N. J., has issued a circular on its CO_2 recorder, explaining the principle of operation, construction and method of installation.

SCALES—Use, abuse and proper care of scales is emphasized in a booklet by the Howe Scale Co., Rutland, Vt., which is of interest to all users of weighing apparatus.

SOOT BLOWERS—The Marion Machine, Foundry & Supply Co., Marion, Ind., presents its line of soot blowers in a catalog recently issued. Installation on various types of boilers is fully illustrated.

RUST PREVENTION—Various grades of preparations for preventing and limiting rust in iron and steel are described in a circular by the Oil Specialties & Supply Co., New York.

OIL BURNER—The performance of a low pressure oil burner on core ovens is described in a report of a survey made by A. C. Nielsen Co., Chicago, on equipment manufactured by the Hauck Mfg. Co., Brooklyn, N. Y.

ELECTRIC TOOLS—A catalog by the Black & Decker Mfg. Co., Towson, Md., describes the portable electric tools and shop equipment manufactured by that company with illustrations, specifications and details.

BAR MILL—The Bonnot Co., Canton, O., has issued an 8-page booklet describing and illustrating a method of preparing pulverized coal for direct firing of boilers. Sectional drawings are included showing the construction of the machines.

WATER SOFTENER—A device for filtering and softening water for domestic and plant use, developed by the Graver Corp., East Chicago, Ind., is described in a booklet that goes into the subject fully and presents a number of illustrations.

GRINDERS AND BUFFERS—A bulletin by the Hisey-Wolf Machine Co., Cincinnati, O., describes its line of combination grinders and buffers, including bench and floor stand types and gives data as to size, current and other specifications.

CHECK VALVES—The Smolensky Valve Co., Cleveland, has issued a bulletin describing a noiseless flanged check valve designed to eliminate water hammer on any pump where a check valve is required. Illustrations show the various features of the device.

STOKERS—Presenting a number of types of stokers the Riley Stoker Corp., Worcester, Mass., covers a wide range with its products presented in a well-illustrated booklet on stokers. It is intended only as an airplane view of the field and the types for various needs.

HOISTS—Instructions for maintaining and operating a motor driven chain hoist made by the Motorbloc Corp., Philadelphia, are contained in a booklet recently published. Wiring diagrams are shown, the various parts listed and the special equipment noted.

MOTORS—Synchronous motors for pumping are described and illustrated in pamphlet recently issued by the Electric Mfg. Co., Minneapolis. The various features are discussed and some of the users of thus type of equipment are listed.

WELDING EQUIPMENT—A junior catalog of welding and cutting equipment has been issued by Smith's Inventions, Inc., Minneapolis. In it are described complete outfits and accessories, as well as various attachments and adapters.

VOLTAGE DROP CONTROL—A bulletin by the General Electric Co., discusses the subject of voltage drop control and the results that follow. It points out where it is of use and what may be accomplished by its use. The bulletin is well illustrated.

CRUCIBLE FURNACE—The Iler Co., Cleveland, has published a pamphlet describing and illustrating a new furnace for melting and refining metals and their alloys. The furnace burns either oil or gas and is so constructed that the crucible may be removed easily.

WOODWORKING MACHINES—Installation photographs form the salient feature of a pamphlet issued by J. D. Wallace & Co., Chicago, setting forth the utility of their woodworking machines, designed for pattern shop and similar work. It attractively presents saws, jointers, band saws and lathes.

MONORAILS—Transportation systems for inside industrial plants are described in a folder of the Cleveland Tramrail division of the Cleveland Crane & Engineering Co. Wickliffe, O. Views show the system applied in the foundry to transport metal, molds, core racks, finished castings and for pouring molds in ferrous and non-ferrous plants.

RUSTPROOFING PROCESS—An electroplating process with varied finishes for preventing rust is described in a booklet of the Udylite Process Co., Kokomo, Ind. The process consists of electroplating iron or steel with a thin coating of cadmium. The article then is baked causing the cadmium to penetrate the iron. An alloy is formed in this way which, it is said, withstands atmospheric corrosion.

The FOUNDRY

SELLING THE OUTPUT

The FOUNDRY

What The Industry Needs Today Is Sales Not Production

Use a Mirror and Not a Telescope TO STUDY THE CONSUMER

I JUST had the privilege of listening to one of those super quality, high pressure, rapid fire, heavyweight salesmen of the kind who doubtless refers to himself, respectfully, as a business ambassador. He did me the favor of calling at the urgent request of Col. A. Gerald Smith who was *not* known to me, but should have been, doubtless, through his many magnificent business enterprises and his worldwide philanthropy which this sales person outlined at length. Col. Smith was just embarking on one of his voyages into the sea of unlimited wealth and he offered me free passage, board, stateroom and a share in the cargo. At any rate, I gathered this impression from the way in which this kind young gentlemen talked. Col. Smith, always considerate of others, had set aside a few shares in a new oil company which he was promoting, only a few mind you—I must not be grasping and expect to take too much—for the colonel must take care of his other friends. Further, I must act immediately, for if I did not appreciate what Col. Smith was doing for me some one else, who I gathered was slightly less in the colonel's favor, would be given my chance and MY STOCK. My future depended upon it—sign on the dotted line.

—: :—

CONTRAST this salesman with another type we all have met from time to time. I mean the one who comes in with one of those pleasant, bungalow-model smiles, nothing above the first floor but the roof. He usually sidles as he walks, like a hound dog with a restless flea riding somewhere in the tonneau. His introduction seldom varies and whether he is selling soup, soap, soda crackers or insurance, he starts, "I'm Mr. Jones of the Consolidated Rock Ribbed Double Jointed Blah Co. Are you in-ter-ess-ted in soap (or whatever he has) today?" Isn't it remarkable how easy it is to turn down a salesman of this type, and don't you take a positive pleasure in telling the suave ambassador model salesmen, previously mentioned, how you really regret to disappoint the eminent Col. Smith, but, "Yes, we'll have no oil stocks today?"

These two young men, represent opposite types of personality. They also typify two widely different lines of thought regarding this mythical personage known as the consumer. More unmitigated bunk has been spoken and written about this *consumer* person than anyone else human, or divine. He is represented as foolish or wise, simple or crafty, nit witted or sharply acute, depending entirely upon the personal slant of the lecturer or writer who picks apart his quivering form before a clinic of interested observers.

P. T. Barnum Says!

THE man who gives the greatest amount of goods of a corresponding quality for the least sum, still reserving to himself a profit, will generally succeed best in the long run.

—: :—

WHY do salesmen so frequently regard consumers or prospects, if you will, as such abstract personages, so unrelated to themselves as to be a bit queer. Consumers, after all are only human beings, cut after the same general pattern, addicted to the same everyday thoughts. We all are consumers and most of us are salesmen in this life. We do not fall either for the over familiarity of the oil salesman or the cringing approach of the other type mentioned. If we are to buy, we want to know what the salesman has to sell. We want to know how the product may be applied to our own needs. If it's castings we are expected to purchase, we want to know why we should buy the particular ones offered. Why are they better suited than a compeitiors, what assurance have we of quality, of delivery, of the reliability of the foundry which is offering them. Economy after all is a main consideration, but economy, does not mean a cut price at the expense of any quality which is necessary to make the castings serviceable.

Perhaps it should not be necessary to stress the point, but a castings salesman should know his product and its market. He should be able to prove that his product is equal to the demands of the service for which it is offered. Even at the risk of making a market for some else, he should demonstrate that the class of castings he is selling is that best adapted to the buyers need.

Phineas, Jr